DTU Library

CDM sustainable development impacts. Developed for the UNEP project 'CD4CDM'

Olhoff, A.; Markandya, A.; Halsnæs, Kirsten; Taylor, T.

Publication date:
2004

Document Version
Publisher's PDF, also known as Version of record

The UNEP project CD4CDM

CDM Sustainable Development Impacts

UNEP

CDM Sustainable Development Impacts

developed for the UNEP project 'CD4CDM'

The project is funded by
the Netherlands Ministry of Foreign Affairs

Anne Olhoff

Anil Markandya

Kirsten Halsnaes

Tim Taylor

UNEP

CDM
Sustainable Development Impacts

UNEP Risø Centre
on Energy, Climate and Sustainable Development
Risø National Laboratory
Roskilde, Denmark

Graphic design:
Finn Hagen Madsen, Graphic Design, Denmark

ISBN: 87-550-3341-5

Contents

Acronyms and Abbreviations

AHP	Analytical Hierarchy Process
CBA	Cost Benefit Analysis
CC	Climate Change
CDM	Clean Development Mechanism
CEA	Cost Effectiveness Analysis
CER	Certified Emission Reduction
CVM	Contingent Valuation Method
DNA	Designated National Authority
GHG	Greenhouse gas
IEA	International Energy Agency
IET	International Emissions Trading
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
JI	Joint Implementation
LULUCF	Land Use, Land Use Change and Forestry
MCA	Multi Criteria Analysis
MDG	Millennium Development Goal
NDP	National Development Plan
NPV	Net Present Value
NSS	National Strategy Study
PDD	Project Design Document
PRSP	Poverty Reduction Strategy Paper
PV	Present Value
SD	Sustainable Development
SSN	SouthSouthNorth
UN	United Nations
UNEP	United Nations Environment Programme
UNDP	United Nations Development Programme
WB	World Bank
WHO	World Health Organisation

1 Introduction and Outline

The Clean Development Mechanism (CDM), an innovative cooperative mechanism under the Kyoto Protocol, is designed with the dual aim of assisting developing countries in achieving sustainable development (SD) and of assisting industrialised countries in achieving compliance with their greenhouse gas (GHG) emission reduction commitments.

The SD dimension is not merely a requirement of the CDM; it should be seen as a main driver for developing country interest in participating in CDM projects. This is so, since apart from GHG emission reductions CDM projects will have a number of impacts in the host countries, including impacts on economic and social development and on the local environment. Furthermore, the selecting of the SD criteria and the assessment of the SD impacts are sovereign matters of the host countries in the current operationalisation of the Kyoto Protocol. National authorities can thus use the SD dimension to evaluate key linkages between national development goals and CDM projects, with the aim of selecting and designing CDM projects so that they create and maximise synergies with local development goals.

A number of CDM project guidelines and manuals have been published to date to cater for a broad audience of emitters, host countries, project developers, stakeholders, and others (see for instance EcoSecurities (2002), Figueres (2002), Pembina (2003), Rosales, J. and G. Pronove (2002 and 2003), Spalding-Fecher (2002), and UNDP (2000)). In the available guidelines, sustainable development is seen as an integrated part of the legal framework of the CDM and it is emphasised that contribution to achieving SD is a purpose of the CDM on equal terms with the reduction of GHG emissions. Generally, however, relatively little attention is paid to the assessment of SD impacts of CDM projects and there are few suggestions on specific assessment methods.

Given the ambiguousness of the concept of SD and the lack of consensus regarding an operational definition, the choice of SD criteria and procedures for assessing these criteria is by no means straightforward. In light of this, the purpose of this guideline is to provide a general introduction to policy makers and experts on how CDM projects can be developed and designed in a way where they assist sustainable development as required in Article 12 of the Kyoto Protocol[1]. The intention is to provide a broad overview of how SD can be understood as a practical policy framework in relation to CDM projects.

1 The guideline is produced to support the UNEP project "Capacity Development for the Clean Development Mechanism" (CD4CDM). Other support publications include a general guideline to the CDM as well as outputs regarding project finance, baseline methodologies, and legal and institutional framework.

The guideline is outlined as follows. Chapter 2 gives a short background to the CDM and briefly explores the implications of the sustainable development dimension of the mechanism. Following this, Chapter 3 outlines and suggests 6 major steps to be followed in a SD assessment of CDM projects. The outline provided, simultaneously introduces the issues addressed in the remaining part of the guideline. In this way, Chapter 4 studies the concept of SD with a particular focus on how it can be related to CDM projects and made operational. Building on this, Chapter 5 focuses on the selection of SD criteria for CDM projects and illustrates how this can be linked to existing efforts, such as National Development Plans (NDPs), the Millennium Development Goals (MDGs), National Poverty Reduction Strategy Papers (PRSPs), etc. Chapter 6 discusses how SD indicators can be selected, suggests a broad list of SD indicators, and provides a hypothetical example of how qualitative SD indicators can be applied to a CDM project. Chapter 7 presents and discusses alternative decision-making tools for evaluation of SD impacts of CDM projects.

In the final chapter, case studies using the three most promising decision-making tools introduced in chapter 7 are presented and analysed to give an impression of how the assessment and evaluation of SD impacts of CDM projects can be and has been undertaken in practice.

1.1 References

EcoSecurities (2002), ***Clean Development Mechanism (CDM): Simplified Modalities and Procedures for Small-Scale Projects, A DfID report.*** Available online at http://www.ecosecurities.com/300publications/smallscale_projet.pdf

Figueres, C. (Editor) (2002), ***Establishing National Authorities for the CDM, a guide for developing countries.*** Center for Sustainable Development in the Americas, Climate Change Knowledge Network, International Institute for Sustainable Development. Available online at http://www.cckn.net/pdf/cdm_national_authorities.pdf

Pembina Institute for Appropriate Development (2003), ***A User's Guide to the Clean Development Mechanism (CDM) – Second Edition.*** Avaliable online at http://www.pembina.org/publications_item.asp?id=148

Rosales, J. and G. Pronove (2002), ***A Layperson's Guide to the Clean Development Mechanism.*** UNCTAD-Earth Council. Available online at http://r0.unctad.org/ghg/sitecurrent/download_c/publications.html

Rosales, J. and G. Pronove (2003), ***An Implementation Guide to the Clean Development Mechanism: Putting the Marrakech Accords into Practice.*** UNCTAD-Earth Council. Available online at http://r0.unctad.org/ghg/sitecurrent/download_c/publications.html

Spalding-Fecher, R. (2002), ***The CDM guidebook, A Resource for Clean Development Mechanism Developers in Southern Africa.*** Energy and Development Research Centre (EDRC) University of Cape Town. Available online at http://www.edrc.uct.ac.za/Publications1.htm

UNDP (2000), ***Project Developers Guide for the CDM.*** Draft prepared by Lloyd Master Consulting.

2 Article 12 of the Kyoto Protocol and the Link to SD

2.1 Background

The 1997 Kyoto Protocol (UNFCCC 1997), a milestone in global efforts to protect the environment and achieve sustainable development, marked the first time that governments accepted legally binding constraints on their greenhouse gas emissions. The Protocol also broke new ground with its innovative cooperative mechanisms, aimed at ensuring global cost effectiveness in curbing these emissions. As it does not matter to the climate where emission reductions are achieved, there is a sound economic argument for achieving them where they are least costly. The Protocol therefore includes three flexibility mechanisms aimed at achieving cost-effective reductions: International Emissions Trading (IET), Joint Implementation (JI), and the CDM. This guideline deals exclusively with the CDM.

The CDM, contained in Article 12 of the Kyoto Protocol, allows governments or private entities in Annex 1 countries to implement emission reduction projects in Non-Annex 1 countries and receive credit in the form of "certified emission reductions," or CERs, which they may count against their national reduction targets. The CDM strives to promote sustainable development in developing countries, while allowing developed countries to contribute to the goal of reducing atmospheric concentrations of greenhouse gases (see Box 1 below)[2]. Thus, the basic principle of the CDM is that all parties involved benefit from the mechanism: the Annex 1 emitter receives credits for the GHG emission reductions, the owner of the CDM project receives a contribution to project finance, and the host country receives benefits related to national sustainable development objectives.

Kyoto Protocol Article 12.2

> "The purpose of the clean development mechanism shall be to assist Parties not included in Annex I in achieving sustainable development and in contributing to the ultimate objective of the Convention, and to assist Parties included in Annex I in achieving compliance with their quantified emission limitation and reduction commitments under Article 3."

2 Apart from the requirements regarding assisting non-Annex I countries in achieving sustainable development and assisting Annex I Parties in achieving compliance with their emission reduction commitments, CDM projects are required to have real, measurable and long-term benefits related to the mitigation of Climate Change (CC); and be based on emission reductions that are additional to any that would have occurred in the absence of certified CDM project activities.

With the 2001 Marrakech Accords, the rules for implementing the CDM were put into place and the operating procedures as well as a Project Design Document (PDD) were subsequently approved at the Eighth Conference of the Parties (COP8) in India.

The number of projects being proposed as potential CDM projects is steadily increasing; in India alone, approximately160 CDM projects have been prepared already, emphasising the need for an operational approach for assessing the SD impacts of CDM projects.

2.2 The SD Perspective of the CDM

According to model projections, developing country GHG emissions are going to exceed industrialised country emissions some time between 2010 and 2020, (IPCC 2001). At the same time, developing countries are struggling with immediate development concerns. For climate change policy, this has two immediate implications. First, if any large-scale reductions of GHG emissions are going to be achieved in the longer term, participation of both industrialised and developing countries is essential. Secondly, if developing countries are to participate in global climate policy, one of the ways forward is a stronger emphasis on integrating sustainable development and climate change policies. The CDM is the first type of climate change mechanism to take into account these challenges and explore the potential for integrating climate change and sustainable development considerations in specific projects.

Energy initiatives and other climate favouring activities already emerge as side-benefits of sound development programmes in many developing countries. Price reform, agricultural soil protection, sustainable forestry, energy sector restructuring – all undertaken without any reference to climate change mitigation or adaptation – have demonstrated substantial effects on curbing the growth of greenhouse gas emissions. This observation suggests that the linkages may also be utilised in the reverse order, i.e. that it may often be possible to integrate development priorities that are vitally important to decision-makers in developing countries into environmental and climate considerations. It opens the potential for climate change policies not to be seen as a burden to be avoided but as a side-benefit of SD policies.

As mentioned above, the basic principle of the CDM is that both developed and developing countries benefit from participating, because synergies between global carbon abatement goals and local sustainable development goals are exploited. From the developing country perspective, the benefits arise both from the increased investment flows **and** from the requirement that these investments should advance host country SD goals.

More specifically, the CDM may contribute to several developing country SD objectives, including:

- Increased energy efficiency and conservation.
- Transfer of technologies and financial resources.
- Local environmental benefits, e.g. cleaner air and water.
- Local environmental side benefits, such as health benefits from reduced local air pollution.
- Poverty alleviation and equity considerations through income and employment generation.
- Sustainable energy production.
- Private and public sector capacity development.

In addition to these benefits, CDM projects may have a number of additional side benefits (or indirect benefits) on other national development objectives related to e.g. rural development, energy access, capacity building, education, and health.

National authorities can thus use the SD assessment of CDM projects as a tool for evaluating key linkages between national development goals and CDM with the aim to select and design projects in a way, where they create, exploit and maximise local development synergies.

Despite the considerable emerging literature on the CDM, few publications address the issues surrounding the SD component of the CDM in depth and there are relatively few examples on SD assessments of CDM projects3. This may reflect a need for building capacity in host countries for performing these assessments.

In the current operationalisation of the Kyoto Protocol, the selecting of SD criteria and assessment of SD impacts of CDM projects is left to the host countries as a sovereign matter. This means that no limitations are imposed on the kind of (sustainable) development benefits that a CDM project generates in addition to the reduction of GHG emissions. While the degrees of freedom regarding SD requirements may certainly be considered to be positive from a developing country perspective, since no limitations are imposed, it can also be viewed as a potential threat to the success of the CDM. For instance, Thorne and Raubenheimer (2001, p.12) note that since there is no clear guidance and no specific requirements regarding SD in the Monitoring, Verification, and Certification texts "…there is not even a minimal standard for SD and nothing to prevent a "race to the bottom" among CDM host countries competing for investors." Without passing any judgment on the relevance of this potential threat, there is something to suggest that the SD dimension of the CDM so far in many cases is handled as an "add-on", rather than a main driver for CDM projects.

It is therefore important to realise that CDM projects have the potential for generating considerable SD benefits, without necessarily implying a heavy additional burden on project developers and investors. Facilitating factors in the process would be:

- Provision of general guidance on selecting SD criteria and indicators as well as on the overall assessment procedure,
- Building capacity for CDM project evaluation, and
- Balancing the need for simple, operational approach with the need for identifying projects that have the largest SD impacts.

It is the ambition of this guideline to further address these factors.

2.3 References

IPCC (2001), *Climate Change 2001 - Third Assessment Report.* Cambridge University Press, the UK

Thorne, S. and S. Raubenheimer (2001), *Sustainable Development (SD) appraisal of Clean Development Mechanism (CDM) projects – experiences from the SouthSouthNorth (SSN) project.* Available online at http://www.southsouthnorth.org

UNFCCC (1997), *Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC).* FCCC/CP/1997/L.7/Add.1, Bonn.

3 We return to some of the existing examples of SD assessments of CDM projects in Chapter 8.

3 Major Steps of a SD Assessment of CDM Projects

3.1 Introduction

The SD assessment of CDM projects is an opportunity for national authorities to evaluate key linkages between national development goals and potential CDM projects with the aim to select and design projects so that they create and exploit local development synergies. The Designated National Authorities (DNAs) will play a key role in securing the realisation of national development benefits of CDM projects, since they are expected to monitor that the requirement of the CDM to assist SD in host countries is fulfilled. To give an overview of how the SD assessment of CDM projects may be coordinated in order to emphasise synergies between the reduction of GHG emissions and national development goals, this chapter suggests a 6-step procedure for conducting such an assessment. The issues introduced in the 6 suggested steps of the procedure are subsequently discussed and analysed in more detail in the remaining chapters of the guideline.

3.2 Project Assessment Steps

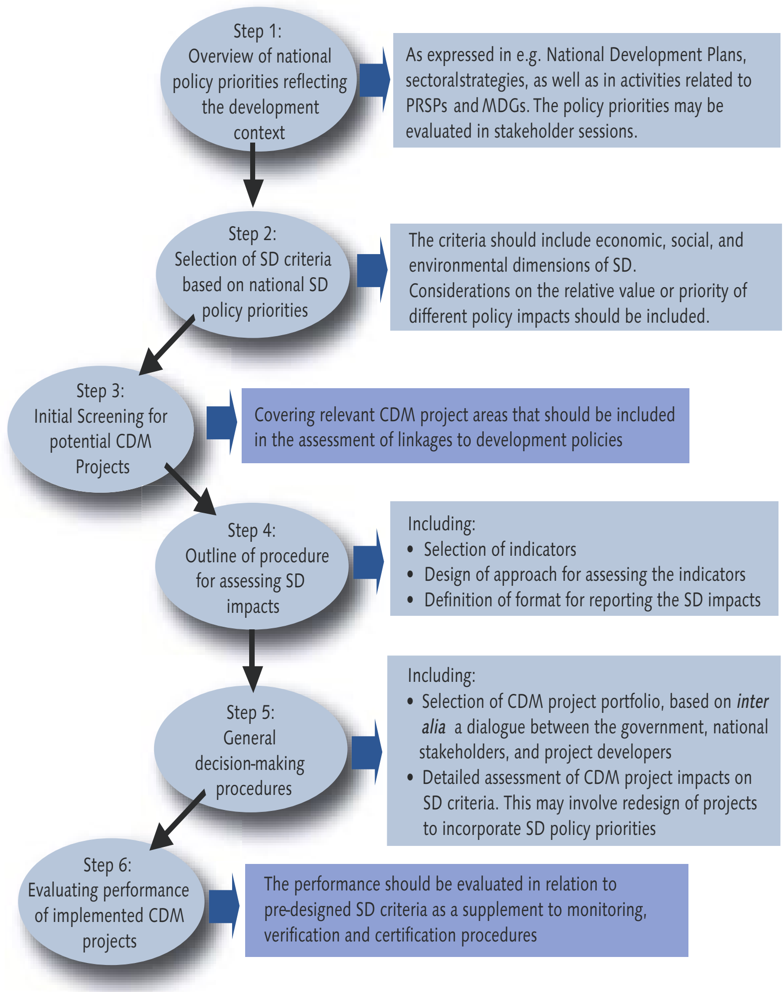
To realise the full potential for synergies between the twin objectives of the CDM, i.e. GHG emission reductions and the achievement of national sustainable development goals, it is recommended that the specific evaluation of a specific CDM project or portfolio of projects be seen as a part of a broader SD assessment process. Accordingly, a 6-step procedure for SD assessment for CDM projects, which takes linkages to the broader national development context into account, is suggested. Figure 1 below illustrates the steps of the procedure.

As can be seen from Figure 1, the two first steps set the background for the specific assessment and evaluation of projects. More specifically, to emphasise the potential for linkages between CDM projects and national development goals, it is relevant to start the assessment process by providing an overview of policy priorities that are expected to be relevant pointers of the broader development context (step 1). The policy priorities may be suggested or evaluated in stakeholder sessions and can be related to political decisions and activities or to official plans that have been developed in other policy contexts. National plans and sectoral strategies as well as activities related to PRSPs and Millennium Development Goals could be useful sources of information in this first step and are further discussed in chapter 5.

In step 2, major SD policy areas that are to be addressed in the CDM project evaluation should be selected, taking as starting point the broad range of national development policy themes identified in step 1. SD criteria for CDM projects can then be synthesised from the major SD policy areas, based on an assessment of the main linkages between CDM projects and national SD priorities.

The selected SD criteria should cover all relevant dimensions of sustainability, including the economic, environmental, and social dimensions. These aspects are further discussed in chapter 4. Furthermore, considerations on the relative value or priority of different policy impacts should be included in the second step.

Figure 1 Major steps of a procedure for assessing SD impacts of CDM projects



In step 3, an initial screening for potential CDM projects is undertaken. The screening should be based on the identification of areas that are considered to be relevant and should be included in the assessment of linkages to development policies. One option is to screen all the sectors of the economy for suitable CDM project candidates, i.e. projects related to energy efficiency, methane recovery, industrial process changes, cogeneration, transportation, agriculture, and land-use. The focus should be on those sectors having the largest GHG emission reduction potential. The Arab Republic of Egypt's National Strategy Study (NSS) on the CDM (Egypt NSS 2002) discussed further in Chapter 8, is an example of a study, where such a screening has been carried out.

When the initial screening for potential CDM projects is carried out, the actual assessment and evaluation of projects can be initiated as illustrated in steps 4 and 5 in Figure 1. Step 4 gives a general outline of a procedure for evaluating SD impacts of CDM projects. First of all, SD indicators should be defined and selected to reflect the SD criteria chosen in step 2. In other words, we need to translate the SD criteria into something that can be used to give us information about the performance of a given CDM project with respect to the chosen criteria. Secondly, an approach for assessing the indicators should be designed and thirdly, definition of a format of reporting the SD impacts of CDM project including measurement standards and aggregation rules for representing economic, social, and environmental information in qualitative and/or quantitative terms should be given. Issues surrounding the selection of indicators and measurement standards are addressed in more detail in chapter 6, whereas chapter 7 presents and analyses various decision-making tools that can be used for assessing the indicators.

The fifth step encompasses broader decision-making on CDM project selection seen in the context of national SD contribution as a part of more general activities to develop CDM project portfolios. It includes the establishment of a dialogue between the government, national stakeholders, and project developers. Following this, detailed assessment of CDM project impacts on SD policies is undertaken as part of the final project preparation. This may eventually involve redesigning (some) projects in order to incorporate SD policy priorities, e.g. if it is found that a project has problematic impacts on one or more of the SD priorities. One example could be a fuel-efficiency project in the transport sector with negative employment impacts as illustrated in chapter 8, where one would have to either redesign the project or combine it with additional employment creating efforts in order to reach a satisfying result.

In the final step of the procedure, it is suggested that a generic evaluation of how implemented CDM projects have performed in relation to pre-designed SD criteria is carried out as a supplement to monitoring, verification and certification procedures.

The steps set out above constitute the ideal way of going from the beginning of the process to the end. Even if this is done at an initial stage for a package of projects, however, new projects will come up and need to be evaluated. In this case steps 3 and 6 can be carried out, given that national priorities, SD criteria and procedures for assessing impacts and evaluating projects are not changed.

3.3 Conclusions

A procedure consisting of 6 steps has been suggested for a generic assessment of SD impacts of CDM projects. The two first steps set the background by establishing an overview of major national development goals and basing the selection of SD criteria for CDM projects on this overview. In the third step, an initial screening of sectors for CDM project candidates is carried out, whereas the fourth step include decisions on definition of indicators and their measurement standards, as well as the design of an approach for assessing the indicators. Step 5 includes establishing a dialogue between the government, national stakeholders, and project developers and carrying out detailed assessments of CDM project impacts on SD policies as part of the final project preparation. The last step is to evaluate the performance of the implemented CDM projects with respect to the chosen SD criteria as a supplement to monitoring, verification and certification procedures.

In the assessment procedure outlined in this chapter, the focus is on generating an integrated portfolio of projects, since it enables comparisons between projects, thereby facilitating that the selected CDM projects are the ones, which have the highest positive impacts on national SD priorities. It should be stressed, however, that the process may also be handled in a less ambitious way, with the assessment of SD impacts of CDM project taking place on a case-to-case basis. The project developers would then be required to demonstrate how sustainable development in the host country is assisted through the project. If, for some reason, it is not feasible for the DNA to generate an integrated portfolio of projects, this approach is one option. Similarly, at later stages of the CDM, subsequent projects may be assessed in this way, based on the knowledge generated from previous projects on main linkages between GHG emission reductions and national SD goals.

3.4 References

Egypt National Strategy Study (NSS) (2002), *Egypt's Strategy on CDM.* The World Bank, Washington D.C.

4 Sustainable Development in Relation to CDM

4.1 Introduction

An effort to assess the SD impacts of CDM projects requires that the host country defines and selects specific aspects of SD considered being important. We call these aspects the SD criteria. However, the definition and selection of SD criteria calls for a general understanding of the concept of SD and of the specific issues related to the operationalisation of the concept in a CDM project context.

In this chapter we briefly present the concept of sustainable development and relate it to the formulation and evaluation of CDM projects. Given the scope of this guideline, the focus is on the practical issue of operationalising the concept rather than on its theoretical foundations[4]. An outline of the concept is provided and the three dimensions of SD are put in a CDM context. Following this, we investigate the implications of analysing SD at the project level. It is exemplified how criteria at the project level may be chosen to cover the three dimensions of SD and how rules may be applied to handled specific cases in which trade-offs arise.

4.2 Sustainable Development and the CDM Perspective

The term sustainable development has its origins in the IUCN 1980 World Conservation Strategy report, but it was with the World Commission on Environment and Development, entitled, 'Our Common Future' (1987) that the term gained broad currency. The Commission defined sustainable development as 'development that meets the needs for the present without compromising the ability of future generations to meet their own needs'. This definition, while useful in drawing attention to the concern with the long-term implications of present day development, asks as many questions as it answers. What constitutes 'needs', and how will these change over time? What reductions in the options available to future generations are acceptable and what are not?

While the operational aspects of sustainable development were not answered by the Brundtland Commission, and in several respects still remains to be answered, there is a common consensus to view sustainable development as encompassing three dimensions, each of which have a major impact on the way in which it is interpreted and operationalised. These are: the economic, the environment and the social dimension. The discussion that follows relates each of these dimensions of SD to a CDM context and looks at the implications of operationalising SD at the project level.

4 For a theoretical introduction to sustainable development in a climate change context, see e.g. Markandya and Halsnaes 2002, chapters 2 and 3.

4.2.1 *The SD Dimensions from a CDM Angle*

In the theoretical literature on sustainable development, environmental concerns are at the core of the analysis of the three SD dimensions as well as in the exploration of the maintenance and composition of stocks of resources or 'capitals' (human, man-made, social and environmental) over time[5]. This is not surprising given the origin of the concept, but in order to operationalise SD in the context of developing countries in general and CDM projects in particular, there is a need for a more pragmatic approach to SD with a stronger emphasis on national development priorities such as poverty reduction, local environmental health benefits, employment generation, economic growth prospects, etc.

The suggested pragmatic approach for CDM projects therefore is to focus on national development criteria related to the three dimensions of SD and let GHG emission reduction represent an additional SD criteria. The rationale for and underlying assumption of this approach is that criteria related to intra-generational equity, including poverty, are central to the concept of SD and a major target of global action.

Indeed, much of the SD literature seeks to identify indicators of precisely this nature, that are linked to the different dimensions of sustainability, but that also provide a guide on how well society is doing with respect to specific targets that affect people's daily lives.

In practice, the pragmatic approach suggested above seems to reflect what developing countries are already employing in their identification of overall sustainability criteria for CDM projects. A review of the literature suggests that although the selection of SD criteria is a national matter, there is a convergence in the choice of these criteria with an emphasis on issues such as local environmental benefits, employment generation, and poverty and equity concerns. Table 4.1 below lists examples of SD criteria for CDM project screening selected from some of the developing countries that have begun to identify these criteria.

Table 4.1 Examples of general SD criteria identified by host countries

Social Criteria
Improve quality of life
Alleviate poverty
Improve equity
Economic Criteria
Provide financial returns to local entities
Result in a positive impact on balance of payments
Transfer new technology
Environmental Criteria
Reduce GHG emissions and the use of fossil fuels
Conserve local resources
Reduce pressure on local environments
Provide improved health and other environmental benefits
Meet local renewable energy portfolio standards and other environmental policies

Source: Based on Pembina (2003)

5 See e.g. Hanley et al (1977), Pearce et al (1990), World Bank (1997)

The table is of course not exhaustive, but it indicates that

- The criteria are largely overlapping with major national development criteria.
- Host countries see a potential for exploiting synergies between CDM projects and national SD priorities.
- A relatively limited number of SD criteria can capture a broad variety of the SD impacts that CDM projects may have.

Well designed CDM projects can thus offer attractive opportunities for supporting development priorities of host countries as reflected in e.g. general national development plans, in sectoral or local environmental plans, and in social development strategies. By including relevant criteria from existing plans and strategies in the selection of SD criteria for CDM projects, the additional effort related to the SD assessment process is furthermore minimised and consistency between environmental and broader development considerations enhanced.

This aspect is important, as it is sometimes argued in the debate that the SD impact assessment of CDM projects merely adds to transaction costs and is a complication that developing countries cannot afford. Taken one step further, some argue that competition for investment may result in a low priority on assuring broader SD impacts of CDM projects (see e.g. Thorne and Raubenheimer 2001, p.12). It should be stressed, however, that while the SD assessment does involve some costs, these costs are expected to be more than outweighed by the benefits gained from better-designed projects with larger positive impacts on national development goals.

4.2.2 Operationalising SD at the Project Level

The CDM is a market based cooperative mechanism operating at the project level. Operationalising SD in a CDM context is therefore equivalent to operationalising SD at the project level. This observation has some implications for the analysis and assessment of the economic, social, and environmental effects of CDM projects. By definition, interventions at the project level only have marginal effects on growth rates, distributional issues, environmental issues, etc. at the national (or global) level. An implication of this is that improvements at the project level lead to marginal improvements at the national level. In other words, while project level intervention does not give us any indication of the overall sustainability of a development path for a given economy, what we can say is that if a CDM project contributes to sustainable development at the project level, it will also have a marginal but positive effect on SD at the national and global level.

In terms of operationalisation, three main issues follow from looking at SD from a project level perspective. First of all, the chosen national SD criteria should be meaningful from a project level perspective in order for them to be represented by appropriate project level indicators[6]. Secondly, the overall sustainable development impacts of the CDM project should be positive. Thirdly, even if the aggregated SD impact of a CDM project is positive, there may be cases where trade-offs arise or where a project has adverse or irreversible effects on one or more of the indicators chosen to reflect the SD criteria. Rules or procedures should be established for taking such cases into account. We will discuss each of these issues in the following.

SD criteria and the project level perspective

As previously emphasised, the SD criteria should be chosen to reflect major national development objectives. At the same, they should be meaningful in a project level context. Table 4.1 listed a number of SD criteria and illustrated that these may be linked to project level activities. Below, Table 4.2 provides some more detailed examples on SD criteria (or SD sub-criteria) that are operational in a project context. The focus areas in Table 4.2 cover a broad range of considerations including GHG emission reductions and project viability (represented by cost-effectiveness) as well as other social, environmental, and economic SD issues. It is noted that many of the examples on SD focus areas may be readily used as indicators (indicators are the subject of chapter 6).

Table 4.2 Suggested CDM SD focus areas

Suggestions on CDM SD Criteria	
Economic dimension	- generate employment - reduce economic burden of energy imports - provide financial returns to local entities - positive impact on BoP - technological change - cost-effectiveness
Social dimension	- increase equity - increase energy access - gender issues - education and training - health - alleviate poverty - legal framework - governance - information sharing
Environmental dimension	- GHG emission reductions - local environmental benefits, e.g. related to: air pollution, water, soil, waste - use of exhaustible resources - use of renewable resources - biodiversity

6 We will return to this aspect in chapter 6.

Table 4.2 should be seen as giving an overview of possible issues that could be relevant to include in a CDM context. It is suggested that the choice of specific focus areas be based on relevance for a given project including its linkages with national development priorities.

Brazil is one of the countries, where specific criteria have been chosen for the SD evaluation of CDM projects. Project participants are required to state whether and how the project activity will contribute to sustainable development, in regards to the following aspects (ICGCC 2003, Annex III)[7]:

- Contribution to local environmental sustainability: Assess the mitigation of local environmental impacts (solid wastes, liquid effluents, atmospheric pollutants, etc.) caused by the project.
- Contribution to development of working conditions and net job creation: Assess the commitment of the project to social and workplace responsibilities, health and education programs and defense of civil rights. Also assess the improvement in the qualitative and quantitative level of employment (direct and indirect).
- Contribution to the distribution of income: Assess the direct and indirect effects of the quality of life of low-income population, noting the socio-economic benefits provided by the project.
- Contribution to training and technological development: Assess the degree of technological innovation of the project and the technologies used in activities comparable to those called for in the project. Also assess the possibility of reproduction of the technologies used, taking account of their demonstration effect, and evaluating the origin of the equipment, the existence of royalties and technology licenses and the need for international technical assistance.
- Contribution to regional integration and linkages with other sectors: The contribution to regional development can be measured in terms of the integration of the project with other socio-economic activities in the region where it is implanted.

It is noticed from the bullets above that the SD criteria chosen by Brazil cover the following of the focus areas listed in Table 4.2: local environmental benefits, employment generation, equity, technological change, training, health, education, and financial returns to local entities.

Aggregated SD impacts and trade-offs

Once the criteria for assessing the SD impacts have been agreed on, the key difficulty in evaluating any policy is in interpreting the results. Many policies that governments would like to pursue have a positive impact on some SD indicators but a negative impact on others. Thus, for example, a policy that is 'good' for the

7 All SD aspects are to be assessed comparing the project scenario with the baseline scenario.

economic indicators may result in a decline in the social or environmental ones. In the case of CDM projects, however, the degree of such trade-offs is less than in other areas. There are numerous examples of sound development policies in developing countries, undertaken without any reference to climate change mitigation or adaptation, having substantial effects on reducing the growth rates of greenhouse gas emissions including; price reforms, agricultural soil protection, sustainable forestry, energy sector restructuring, etc. Conversely, CDM projects often, although not in all cases, have positive impacts on many development priorities. For this reason it may be possible to integrate development priorities that are vitally important to decision-makers in developing countries in environmental and climate considerations. It opens the potential for climate change policies to be seen not as a burden to be avoided but as a side-benefit of sound and internationally supported development.

While it is obvious that the positive SD impacts of a project should more than outweigh the negative SD impacts in order for the project to qualify as a CDM project, the handling of potential trade-offs is more complicated. The discussion of specific tools for assessing the different SD impacts is left to Chapter 7 and practical examples of their application are provided in Chapter 8. However, the literature on SD suggests a number of more general methods or 'rules' for handling trade-offs and/or negative impacts that can be adapted and applied to CDM projects. Below, two of these rules are discussed[8].

One of the rules is the so-called *shadow project constraint*, suggested by Pearce *et al* (1990). The original idea is that if a project results in serious environmental damages, it should be obliged to undertake a 'shadow project' where environmental mitigation or improvement is carried out to a value at least equal to the damage done.

In a CDM project context, this rule could be extended to cover the social and economic dimensions and be used to demand that any significant adverse effects (social, environmental, or economic) be compensated by investment in an activity that creates a social, economic or natural resource of similar or greater value. Similarly, the rule could be widened to cover cases, where a potential CDM project has very limited SD impacts apart from GHG emission reductions. One example of this could be to require a training component as part of a given project to enhance criteria related to education and training as well as to information sharing. Another option could be to require use of locally produced inputs, where possible. This would enhance local business development as well as employment generation.

In practice, it is likely to be difficult to create a separate shadow project as a supplement to a CDM project. However, the rule could serve as inspiration for build-

8 For a full description of sustainability concepts and rules, see e.g. Markandya and Halsnaes (2002), Chapter 2.

ing in specific SD enhancing components as part of a given CDM project in cases where SD impacts are weak.

Another rule, which could be of relevance, is the *Safe Minimum Standards* (SMS) approach, developed by Ciriacy-Wantrup (1952) and Bishop (1978). It stems from a concern that the type of calculation carried out under cost benefit-analysis cannot be used to plan for sustainability, because the valuation of damage to ecosystems cannot reflect sustainability principles. In the absence of a reliable calculation, it is suggested that ecosystem damage be limited so that the remaining stocks are above safe minimum levels, usually calculated as the minimum levels required for the ecosystem to remain viable.

The SMS rule, therefore is to "prevent reductions in the natural capital stock below the safe minimum standard identified for each component of this stock unless the social opportunity costs of doing so are 'unacceptably' large" (Hanley *et al* 1997). This implies, for example, that pollution emissions and biodiversity loss should be kept below identified safe levels. The indicator of sustainability implied by this criterion is then whether or not the SMS is breached for any class of resource.

4.3 Conclusions

This chapter has provided a brief introduction to the concept of sustainable development and illustrated how criteria for the three dimensions of sustainability, i.e. the environmental, social, and economic dimension, may be chosen to simultaneously reflect development priorities of developing countries and be relevant in a CDM project context.

The focus has been on the operational aspects of sustainable development in a CDM context and on selecting national SD criteria. The identification of SD criteria has been initiated in numerous countries and it has been illustrated that a relatively limited number of SD criteria can capture a broad variety of the SD impacts that CDM projects may have. Furthermore, it is indicated that well designed CDM projects offer attractive opportunities for supporting development priorities of host countries.

4.4 References

Bishop, R.C. (1978), *Endangered Species and Uncertainty: The Economics of a Safe Minimum Standard.* American Journal of Agricultural Economics 60, pp 10-18.

Cirriacy-Wantrup, S.V. (1952), *Resource Conservation: Economics and Policies.* Berkley and Los Angeles: University of California.

Hanley, N.D., J.F. Shogren, and B. White (1977), *Environmental Economics in Theory and Practice.* Macmillan Press, Basingstoke, UK.

Interministerial Commission on Global Climate Change (ICGCC) (2003), *Resolution #1 of September 11, 2003.* Ministério da Ciência e Tecnologia, The Brazilian Federal Government. Available online at http://www.mct.gov.br/clima/ingles/comunic/resolu.htm

IUCN (1980), *World conservation strategy: living resource conservation for sustainable development.* IUCN-WCS-004

Markandya, A. and K. Halsnaes (eds.) (2002), *Climate Change and Sustainable Development. Prospects for Developing Countries*. Earthscan Publications Ltd., London, UK

Pearce, D. W., E.W. Barbier, & A. Markandya (1990), *Sustainable Development.* Earthscan Publications Ltd., London, UK

Pembina Institute for Appropriate Development (2003), *A User's Guide to the Clean Development Mechanism (CDM)*. Available online at http://www.pembina.org/publications_item.asp?id=148

Thorne, S. and S. Raubenheimer (2001), *Sustainable Development (SD) appraisal of Clean Development Mechanism (CDM) projects – experiences from the SouthSouthNorth (SSN) project*. Available online at http://www.southsouthnorth.org

World Bank (1997), *Expanding the Measure of Wealth: Indicators of Environmentally Sustainable Development*. The World Bank, Washington D.C.

World Commission on Environment and Development (1987), *Our Common Future.* Oxford University Press, London.

5 Selecting SD Criteria for CDM Projects - The National Development Context

5.1 Introduction

This chapter looks at a range of ongoing development strategy activities that can be used as a general background for selecting and assessing SD criteria for CDM project evaluation. The activities include specific national economic and sectoral planning activities as specified in e.g. national development plans, as well as internationally coordinated activities related to the development of PRSPs and to the Millennium Development Goals (MDG) implementation strategies (UNDP, 2003). It is acknowledged that the most important activities for selecting SD criteria are the national economic and sectoral planning activities. However, to illustrate how linkages to the internationally coordinated activities that are taking place may be utilised in a CDM context, the main focus of the chapter is on how PRSP and MDG activities may be used as a background for selecting SD criteria for CDM projects.

Section 5.2 looks at the potential links between the Millennium Development Goals, sustainable development and CDM projects and illustrates how the MDGs can be linked directly to national development plans, exemplified by India's 10th development plan, and to CDM activities taking the energy sector as an example. Following this, a short introduction to the World Bank and IMF Poverty Reduction Strategy Papers (PRSPs) is given in section 5.3, whereas section 5.4 demonstrates how SD criteria and indicators for CDM project evaluation can be generated based on national PRSP case examples.

5.2 The Millennium Development Goals, SD and the CDM

United Nations (UN) Global Summits and Conferences held throughout the 1990s addressed global social, economic and environmental issues facing both developing and developed countries in the world. The related Conventions and Declarations were synthesized in the Millennium Summit of September 2000, where 147 heads of the State and Government and 191 nations adopted a Millennium Declaration. A set of goals, numerical targets and quantifiable indicators, which is known as the Millennium Development Goals (MDGs), grew out of the Millennium Declaration. The eight MDGs comprise 18 targets and 48 indicators, covering poverty reduction, universal primary education, gender equality, child mortality reduction, maternal mortality reduction, reduction in HIV/Aids and malaria, environmental sustainability and global partnership for development. Most of the numerical targets are to be achieved over the 25-year period from 1990-2015. A list of the MDGs, their links to the sustainability literature and their relevance to the CDM type projects is summarised in Table 5.1.

Table 5.1 The Millennium Development Goals (MDGs)

Goals and Targets	SD LINK	CDM Link
Goal 1: Eradicate extreme poverty and hunger		
Target 1: Halve, between 1990 and 2015, the proportion of people whose income is less than one dollar a day	Intra-generational equity is a key component of the social dimension of SD	HIGH
Target 2: Halve, between 1990 and 2015, the proportion of people who suffer from hunger	Reduction of poverty is a key component of the social dimension of SD	MEDIUM
Goal 2: Achieve universal primary education		
Target 3: Ensure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling	Relevant to intra-generational equity (key to social dimension) as well as investment in human capital	LOW
Goal 3: Promote gender equality and empower women		
Target 4: Eliminate gender disparity in primary and secondary education preferably by 2005 and to all levels of education no later than 2015	Relevant to intra-generational equity (key to social dimension) as well as investment in human capital	LOW
Goal 4: Reduce child mortality		
Target 5: Reduce by two-thirds, between 1990 and 2015, the under-five mortality rate	Relevant to intra-generational equity (key to social dimension) as well as investment in human capital	MEDIUM
Goal 5: Improve maternal health		
Target 6: Reduce by three-quarters, between 1990 and 2015, the maternal mortality ratio	Relevant to intra-generational equity (key to social dimension) as well as investment in human capital	LOW
Goal 6: Combat HIV/AIDS, malaria and other diseases		
Target 7: Have halted by 2015, and begun to reverse, the spread of HIV/AIDS	Relevant to intra-generational equity (key to social dimension) as well as investment in human capital	LOW
Target 8: Have halted by 2015, and begun to reverse, the incidence of malaria and other major diseases		MEDIUM
Goal 7: Ensure environmental sustainability		
Target 9: Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources	Relevant to the environmental dimension: Land Area Under Forest Land Area Protected Energy Use (KGOE/$GDP) CO_2 Per Capita Proportion of Population Using Solid Fuels	HIGH HIGH LOW HIGH HIGH HIGH HIGH
Target 10: Halve, by 2015, the proportion of people without sustainable access to safe drinking water	Relevant to the environmental dimension and to social dimension	MEDIUM
Target 11: By 2020, to have achieved a significant improvement in the lives of at least 100 million slum dwellers		

The MDGs are an agreed set of goals and indicators that will drive the development agenda, including, to a considerable extent, the agenda for climate change projects. Hence it is important to understand the links between these and the sustainability dimensions discussed in the previous chapter and to know which goals and corresponding indicators will be most important for the CDM projects.

In this context the most important observations about the MDGs are the following:

- The major focus is poverty reduction. Goals 1-5 have a direct impact on poverty and all the other goals also contribute to poverty reduction. This links of course strongly to the social dimension of sustainability.
- There is little direct relationship to the economic dimension of sustainability and the MDGs.
- In the environmental dimension, there is an indirect concern with protecting resources for the future (e.g. land area under conservation and climate change), but most of the attention is on the impacts of the environment on health and quality of life.

These important observations give a steer on which general direction the CDM programme should focus if it is to be consonant with the politically determined development goals. This is, of course, quite possible, and Table 5.1 gives a first impression of where CDM projects may impact on the MDGs. Apart from the environmental MDG those relating to poverty and health are the ones most likely to be important and, as chapter 8 shows, the effects of CDM projects on these goals may often be significant.

5.2.1 Millennium Development Goals in Relation to National Development Plans and Energy Policy Goals

While Table 5.1 above illustrated the MDGs and their links to SD and CDM at the general level, the following Table 5.2 illustrates how the MDGs mirror national development goals, in this case illustrated by national development plans for India.

Table 5.2 Development goals and targets in India

Millennium development goals and global targets[1]	India's 10th plan (2002-2007) and beyond targets[2, 3, 4]
Goal 1: Eradicate extreme poverty and hunger	
Target 1: Halve, between 1990 and 2015, the proportion of people whose income is less than $1 a day Target 2: Halve, between 1990 and 2015, the proportion of people who suffer from hunger	- Double the per capita income by 2012 - Reduction of poverty ratio by 5 percentage points by 2007 and by 15 percentage points by 2012 - Reduce decadal population growth rate to 16.2% between 2001-2011 (from 21.3% during 1991-2001)
Goal 2: Achieve universal primary education	
Target 3: Ensure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling	- All children in school by 2003; all children to complete 5 years of schooling by 2007 - Increase in literacy rates to 75% by 2007 (from 65% in 2001)
Goal 3: Promote gender equality and empower women	
Target 4: Eliminate gender disparity in primary and secondary education, preferably by 2005 and in all levels of education no later than 2015	- At least halve, between 2002 and 2007, gender gaps in literacy and wage rates
Goal 4: Reduce child mortality	
Target 5: Reduce by two-thirds, between 1990 and 2015, the under-five mortality rate	- Reduction of Infant mortality rate (IMR) to 45 per 1000 live births by 2007 and to 28 by 2012 (115 in 1980, 70 in 2000)
Goal 5: Improve maternal health	
Target 6: Reduce by three-quarters, between 1990 and 2015, the maternal mortality ratio (MMR)	- Reduction of MMR to 2 per 1000 live births by 2007 and to 1 by 2012 (from 3 in 2001)
Goal 6: Combat HIV/AIDS, malaria and other diseases	
Target 7: Have halted by 2015 and begun to reverse the spread of HIV/AIDS Target 8: Have halted by 2015 and begun to reverse the incidence of malaria and other major diseases	- Have halted by 2007; 80 to 90% coverage of high risk groups, schools, colleges and rural areas for awareness generation by 2007 - 25% reduction in morbidity and mortality due to malaria by 2007 and 50% by 2010

Goal 7: Ensure environmental sustainability	
Target 9: Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources Target 10: Halve by 2015 the proportion of people without sustainable access to safe drinking water Target 11: Have achieved by 2020 a significant improvement in the lives of at least 100 million slum dwellers	- Increase in forest and tree cover to 25% by 2007 and 33% by 2012 (from 23% in 2001) - Sustained access to potable drinking water to all villages by 2007 - Commission 14.4 GW hydro and 3 GW by other renewables in a total power generation capacity additions of 41.1 GW between 2002-2007 - Electrify 62,000 villages by 2007 through conventional grid expansion, remaining 18,000 by 2012 through decentralized non-conventional sources like solar, wind, small hydro and biomass. - Cleaning of all major polluted rivers by 2007 and other notified stretches by 2012
Goal 8: Develop a global partnership for development	
Target 12: Develop further an open, rule-based, predictable, non-discriminatory trading and financial system (includes a commitment to good governance, development, and poverty reduction - both nationally and internationally) Target 16: In cooperation with developing countries, develop and implement strategies for decent and productive work for youth Target 17: In cooperation with pharmaceutical companies, provide access to affordable essential drugs in developing countries Target 18: In cooperation with the private sector, make available the benefits of new technologies, especially information and communications technologies	- Expeditious reformulation of the fiscal management system to make it more appropriate for the changed context - Tenth plan includes state-wise break up of the broad developmental targets. - Higher integration with the global economy - Create 50 million employment opportunities by 2007 and 100 million by 2012 (current back-log of unemployment is around 9%, equivalent to 35 million persons)

Note: *Millennium targets 13 and 14 refer to special needs of least developed, land locked and small island countries. India is party to several international conventions and programmes assisting these countries. India is also implementing policies in line with target 15 that exhorts amelioration of debt of developing countries, including own debt, under global cooperation.*

[1] Human Development Report, 2003 (UNDP, 2003a)

[2] Planning Commission (PC, 2002a), Tenth Five Year Plan, Government of India, Vol. 1 (pp 6-8), Vol. 2 (pp 108, 117, 909, 914, 927)

[3] For the most recent year between 1985-1999 (UNDP, 2002), pp 176

[4] *Planning Commission (PC, 2002b), India Vision 2020, SP Gupta Committee report, Planning Commission, 2002 (pp 93)*

Source: Based on IIM (2003)

Table 5.3 Potential links between MDGs and energy sector CDM projects

MDG Targets	Sectoral/Project Level Themes
1. To halve between 1990 and 2015, the proportion of the worlds population whose income is below 1$ a day	- Energy for local enterprises - Lighting to facilitate income generation - Energy for machinery - Employment related to energy provision
2. To halve between 1990 and 2015, the proportion of people who suffer from hunger	- Energy for machinery and irrigation in agriculture
3. To ensure that, by 2015, children everywhere will be able to complete a full course of primary schooling	- Reduce time spent by children on energy provision. - Lighting for reading - Energy for educational media including TV and computers
4. Ensuring that girls and boys have equal access to primary and secondary education, preferably by 2005, and to all levels of education no later than 2015	- Modern energy services free girls and young women's time spent on energy provision - New electronic educational media makes it easier for girls to get information from home
5. To reduce by two-thirds, between 1990 and 2015, the mortality rate for children under the age of five years	- Energy supply can support health clinics - Reduced air pollution from traditional fuels - Reduced time spend on fuel collection can increase the time spend on children's health care
6. To reduce by three-quarters between 1990 and 2015 the rate of maternal mortality	- Energy provision for health clinics - Reduced air pollution from traditional fuels and other health improvements.
7 HIV/AIDS, malaria and other major diseases	- Energy for health clinics - Cooling of vaccines and medicine
8. To stop the unsustainable exploitation of natural resources	- Deforestation caused by woodfuel collection - Use of exhaustible resources

Table 5.2 illustrates the direct connection between the MDGs and national development targets. In order to make a connection to CDM projects, Table 5.3 demonstrates how short to medium term development goals as included in the Millennium Development Goals (UNDP, 2003b) are related to energy policy objectives.

The linkages shown in Table 5.3 can be used as a starting point for considering the relationship between CDM project implementation and SD visions. If a country, for example, is considering implementing the first MDG of reducing the share of the population with an income below 1$ per day, then the policies can include e.g. increased energy supply for local enterprises and machinery, lighting to facilitate income generation, and employment generation related to these energy provisions. A number of CDM projects potentially could support these objectives if the energy

Examples of Project Level Indicators
- Quantity of energy supplied to enterprises, lighting, machinery etc. - Household income generated as a result of the project - Energy costs and the share of this in household income, production costs etc. - No of people employed
- Energy supply and costs related to food production - Impacts of projects on costs of food and food production
- School enrolment rates - Time spent in education - Quantity of energy supplied for lighting and electronic media for education
- Free time for girls and young women - Energy supply to electronic media in homes
- No of new health clinics or quantity of services - Mortality rates - Air pollution
- Energy supply for clinics and costs - Air pollution and health impacts
- Energy supply - Cooling capacity
- Deforested area - Quantity of resources used relative to stock

supply is cleaner than existing alternatives in terms of GHG emissions.

Another example is the seventh MDG aiming at stopping unsustainable exploitation of natural resources. Decreased woodfuel collection in forests will contribute to this goal, and some CDM projects as for example related to the introduction of modern energy forms can decrease the use of woodfuel. In this way, many CDM projects can support MDGs, if the projects are designed in a way, where they have an integrated approach to poverty alleviation and the environment.

5.3 PRSPs and SD criteria for CDM Projects

Another possibility is to use the activities related to the development of national PRSPs as a general background for selecting SD criteria for CDM projects. The World Bank and the IMF introduced the PRSP approach in 1999 as a new framework for poverty alleviation to be used as a basis for concessional assistance from the agencies. The PRSP strategy framework sees poverty as multi-dimensional and extending beyond low levels of income. It includes the following dimensions (World Bank, 2001):

- Lack of opportunity, which relates to low levels of consumption/income and the returns of different assets.
- Low capabilities i.e. related to health, education and nutrition.
- Low level of security in terms of exposure to risk and income shocks.
- Empowerment as the capability to participate, negotiate, change, and hold accountable institutions.

Countries are supposed to develop their own PRSPs including specific goals and monitoring procedures. This process is supported by technical assistance from the World Bank and a source book (World Bank 2001) giving detailed recommendations on how countries can develop their own PRSP strategy for various sectors.

It is pointed out that promotion of the productive sectors may have particular important impacts for the poor. This will suggest public interventions to support the build-up of human, land and infrastructure that poor people own or to which they have access (Panos, 2002). Specific sectoral policies promoting energy access and food security will be key elements in such infrastructure.

The PRSPs do not explicitly include or address climate change related issues, but have specific sectoral chapters covering the energy sector, agriculture, water and other major climate change related sectors. In this way, the PRSPs are supposed to cover a number of the same issues that have been identified as key linkages between development and climate change. Their greatest value is in showing how sectoral programs and policies can be designed in such a way as to be more ‘pro-poor’.

The general idea of the PRSP framework is to combine the identification of major issues in poverty alleviation, definition of strategic goals, and design of a monitoring and evaluation procedure in order to track progress. In this way, national PRSPs are supposed to include information about development indicators and goals, which potentially can provide part of the background for identifying SD goals that can be used in CDM project evaluation.

5.4 Examples of National PRSP Goals and their Relationship to SD Impacts of CDM Projects

A number of countries have already finished their first national PRSP strategy and the following section provides a number of examples from these plans on PRSP goals and indicators that can also be relevant to apply to CDM project evaluation. The idea is to demonstrate, how CDM projects in practice can be selected and designed in a way, where they support a broader set of national development priorities as those formulated in PRSP strategies.

The focal areas of PRSPs are generally industry, water, agriculture, social development, health, and specific poverty alleviation goals rather than energy sector development, which is particularly important to GHG emission reduction options such as CDM projects. There are, however, examples of energy sector development goals in most of the plans that are relevant to consider in relation to CDM projects.

5.4.1 PRSP Goals for the Energy and Transport Sector in Sri Lanka

The Sri Lanka PRSP strategy on power sector development (Government of Sri Lanka 2002, p.179) includes examples of national goals that can be relevant to consider in relation to CDM projects.

One of the objectives of this plan is to meet national power demand in an affordable and efficient manner, which will include to:

- Invite expressions of interest for coal power plant in 2002
- Secure finances for transmission and distribution investments to complement private sector financing in generation
- Develop a strategy to provide electricity for the rural sector

In relation to potential CDM projects, these specific PRSP goals of Sri Lanka can be addressed through assessing how CDM projects can support rural electrification and generate financial transfers that support the general power system development. As noted above, the PRSP literature can help policy-makers to design the programs with a particular eye on how they impact positively on the poor (for example, by choosing options that are low cost and affordable rather than ones that are technically superior but more costly).

The PRSP for Sri Lanka also comprises a transport sector plan that includes an urban air quality component (Government of Sri Lanka 2002, p. 186). The plan states: "Deteriorating air quality is one of the most serious environmental matters faced by the transport sector in Sri Lanka. The health effect it has on the population is well documented. However, no meaningful steps are yet to be taken to reduce the worsening air quality especially in Colombo and its suburbs." It is recommended to implement an air quality program including lead free petrol, low sulphur diesel, and vehicle testing.

As we will see in chapter 8, many CDM projects have the potential to support the goal of improved local air quality and it is straightforward to measure impacts on sulphur, NO_x, particulates and other air emissions from CDM projects. Again, policies in this area can be more or less beneficial to the poor and the challenge is to design them in such a way to be as beneficial to the poor as possible.

5.4.2 PRSP Goals for the Energy Sector in Senegal

The PRSP for Senegal includes a number of goals that are relevant for CDM project implementation (Republic of Senegal 2002, p. 60). The PRSP goals for the energy sector are indicated below in Table 5.4.

Table 5.4 PRSP goals for the energy sector in senegal

PRSP Goals	Measures
Develop production capacities	- Promotion of energy as the driving force in productive activity
Develop energy infrastructures and services Diversify sources of energy	- Involvement of the private sector, village associations, and local authorities - Establishment of niche-market energy sources Promotion and development of new and renewable energies - Integration of renewable energy sources into rural development - Promotion of kerosene and solid fuels - Exploitation of biomass residues for energy purposes
Improve and ensure stable access by populations to domestic fuels	- Construction of charcoal terminals - Outreach campaign to make population aware of options for rational - Energy use - Access by populations to domestic fuels - Establishment of a fund specifically intended to facilitate the acquisition of more efficient cooking equipment
Enhance rural electrification	- Expansion of rural electrification - Program of support for the development of rural electrification - Electrification of all main rural towns - Electrification of education and health infrastructures - Promotion of local rural electrification initiatives

A number of these PRSP goals for Senegal can be directly related to CDM projects. One option is to consider in the SD assessment whether a given CDM project assists PRSP goals such as improved energy access of the rural population and/or increased energy efficiency and utilization of renewable energy sources. The PRSP goals can also be used as a source of inspiration for focal CDM project areas in the initial project screening suggested in chapter 3.

The national PRSPs are at present less detailed for the energy sector area than for agriculture, water supply and social development including health and education. However, many CDM projects, including energy projects, can have significant linkages to water or agricultural policies as well as to social development goals.

5.5 Conclusions

The selection of SD criteria for CDM projects should be based on the identification of national development policy priorities. This chapter has illustrated how national economic and sectoral planning as well as internationally coordinated activities related to the development of PRSPs and to the Millennium Development Goals (MDG) implementation strategies may be used as a background for selecting SD criteria for CDM projects.

The MDGs are an agreed set of goals and indicators that will drive the development agenda, including, to a considerable extent, the agenda for climate change projects. Hence it is important to understand the links between these and the three dimensions of sustainable development and to know which goals and corresponding indicators will be most important for the CDM projects. In this context, the three most important observations about the MDGs are; that their major focus is poverty reduction, which of course links strongly to the social dimension of sustainability; that there is little direct relationship to the economic dimension of sustainability and the MDGs; and, that in the environmental dimension, most of the attention is on the impacts of the environment on health and quality of life. Based on this, it is concluded that apart from the environmental MDG, those relating to poverty and health are the ones most likely to be important and the effects of CDM projects on these goals may often be significant.

The potential linkages between the efforts related to the MDGs and the selection of SD criteria for CDM projects were further illustrated by providing an overview of how the MDGs are related to specific targets in national development plans and may be linked to energy sector policy goals.

Another internationally coordinated activity related to sustainable development is the PRSP framework, where the general idea is to combine the identification of major issues in poverty alleviation, definition of strategic goals, and design of a monitoring and evaluation procedure in order to track progress. In this way, national PRSPs are supposed to include information about development indicators and goals, which may provide relevant background input for the identification of SD criteria that can be used in CDM project evaluation.

A number of countries have already finished their first national PRSP strategy and the chapter has demonstrated, how CDM projects in practice can be selected and designed in a way, where they support a broader set of national development priorities as those formulated in PRSP strategies.

5.6 References

Government of Sri Lanka (2002), ***Regaining Sri Lanka: Vision and Strategy for Accelerated Development.*** Available online at http://poverty.worldbank.org/files/Sri_Lanka_PRSP.pdf

Indian Institute of Management (IIM) (2003), ***Workshop on Development and Climate.*** IIM Ahmedabad, India

Panos (2002), ***Reducing Poverty. Is the World Bank's strategy working?*** The Panos Institute, London UK.

Planning Commission (2002a), ***Tenth Five Year Plan.*** Government of India, Vol. 1 (pp 6-8), Vol. 2 (pp 108, 117, 909, 914, 927)

Planning Commission (2002b), ***India Vision 2020.*** SP Gupta Committee report, Planning Commission (pp 93)

Republic of Senegal (2002), ***Poverty Reduction Strategy Paper.*** Available online at http://poverty.worldbank.org/files/Senegal_PRSP.pdf

UNDP (2003a), ***Human Development Report.*** Available online at http://hdr.undp.org/reports/global/2003/

UNDP (2003b), ***Global indicators (Millennium Development Goals).*** Available online at http://www.undp.org/mdg/goalsandindicators.html

World Bank (2001), ***Poverty Reduction Source Book.*** Overview p. 2. Available online at http://poverty.worldbank.org/library/view.php?topic=3438&id=8124

6 Selecting SD Indicators for CDM Projects

6.1 Introduction

One way of establishing a linkage between CDM projects and national sustainable development criteria is through the use of project evaluation indicators that reflect specific CDM project issues such as financial costs and GHG emission reductions as well as development criteria including economic, social, and environmental sustainability dimensions.

The application of SD indicators to CDM project evaluation is a means of checking how the CDM potentially can be used to create synergies with host country development objectives. Based on the chosen SD criteria representing focal policy areas as discussed in the previous chapters, the indicators for the SD assessment should be selected so that they simultaneously reflect the SD criteria and are easy to use and understand. A few more detailed comments are presented in section 6.2 on how SD indicators can be selected in order to meet these objectives. Section 6.3 gives an overview of indicators, which may be used depending on project details and design to evaluate general economic, environmental, and social sustainability dimensions of CDM projects. It also suggests a smaller core set of indicators that all CDM projects must look at. Finally, section 6.4 illustrates how SD indicators can be applied to a qualitative assessment of a hypothetical CDM project.

6.2 Desirable Properties of SD Indicators

First of all, an SD indicator or set of indicators should be comprehensive and measurable in order to be useful to the decision maker. Comprehensiveness should be understood in relation to the scope of the chosen SD criteria reflecting the economic, environmental, and social dimensions. Furthermore, comprehensiveness implies that knowledge of the level of a specific set of indicators enables the decision maker to assess the extent to which a given objective has been reached. Measurability means that the indicator can be defined and measured unambiguously and without excessive use of effort, time and costs.

In the case of CDM projects, the assessment of SD will involve a set of indicators and these should be selected so that they are:

- Complete: The set of indicators should be adequate to indicate the degree to which the overall objective of sustainability has been met. This implies that key SD issues are reflected in a local and global context, and that the economic, environmental, and social dimensions are covered.
- Operational: The set of indicators should be used in a meaningful way in the analysis. This in turn implies that the indicators should provide a balanced

coverage of the area; that they are well defined and unambiguous; and that they should be policy-relevant, i.e.

- Relate to areas that will be affected by policy decisions
- Can be understood and related to policy decisions
- Can be interpreted

- Decomposable: A formal decision analysis requires both that the decision maker's preferences for consequences and his/her judgments about uncertain events are quantified. Because of the complexity involved, this will be extremely difficult for decision problems involving even a relatively modest number of indicators. It is therefore recommended that the set of indicators is decomposable, i.e. that the decisions can be broken down into parts involving a smaller number of indicators.
- Non-redundant: The indicators should be defined to avoid double counting of consequences.
- Minimal: It follows from the above that it is desirable to keep the set of indicators as small as possible. For instance it may be possible to combine indicators to reduce the dimensionality of the decision problem. It may also be possible to minimise costs, time and effort by letting the set of indicators be partly based on available data that is of a high quality and is regularly updated.[9]

6.3 Examples of Potential SD Indicators for CDM Project Evaluation

While the previous section gave some guidance regarding the process of defining and selecting indicators for assessing the SD impacts of CDM projects, this section presents an overview in table format of indicators that may be used to evaluate general economic, environmental, and social sustainability dimensions of CDM projects, based on the SD criteria selected by CDM project host countries (see Table 6.1 below). The list of indicators presented in the table is not exhaustive and should only be seen as providing examples of criteria and indicators that countries may decide to use.

A few comments on applying SD indicators to CDM project evaluation are appropriate. First of all, a large number of SD indicators is available in the literature and it is therefore suggested that existing statistical material and measurement standards for the indicators be used to the extent possible. In this way economic SD indicators may, for example, be inspired by statistical standards from the United Nations (UN), energy can follow the International Energy Agency (IEA) format, and GHG emissions and carbon sequestration can follow Intergovernmental Panel on Climate Change (IPCC) guidelines. Well-defined international standards from e.g. the United Nations Development Programme, the World Bank (WB), and the World Health Organisation (WHO) may cover a number of social dimensions like

9 For an elaborated discussion of desirable properties of indicators, see e.g. Keeney and Raiffa 1993.

equity aspects, health, and education. Similarly, there are international standards for environmental impact data, used in e.g. environmental impact assessments.

Table 6.1 Examples of major sustainability indicators that can be used in relation to CDM projects

SD criteria	Sectoral/Project level indicator	Measurement standard of indicator
Economic		**Quantitative:**
Cost Effectiveness	Net costs Financial flows	Financial costs Social cost
Growth	Income generation	Net surplus
Employment	Employment	No. of man-years created or lost
Investments	Activity in energy sector, industry, agriculture etc.	Foreign exchange requirement ($ and share of investment)
Sectoral development	Technology access Market creation	Physical measures like energy demand and supply, economic measures, energy efficiency and affordability, energy security
Technological change	Innovation Learning	No of technologies Price of technologies and maintenance Cost development over time
Environmental		**Quantitative**
Climate change	GHG emissions	GHG emissions
Air pollution	Local air pollution, particulates Environmental health benefits	Emissions of SO2, NOx and particulates Monetary value of environmental health benefits
Water	Rivers, lakes, irrigation, drinking water	Emissions in physical units Damages in physical and monetary units
Soil	Exposure to pollutants	Emissions in physical units Damages in physical and monetary units
Waste	Waste discharge and disposal	Emissions in physical units Damages in physical and monetary units
Exhaustible resources	Fossil fuels	Physical units
Biodiversity	Specific species	Number, monetary values

Table 6.1 continued

SD criteria	Sectoral/Project level indicator	Measurement standard of indicator	
Social		**Quantitative**	**Qualitative**
Legal framework	Regulation, property rights	Physical regulation standards, tax value and revenue Land area distribution	Outline of major rules and property rights
Governance	Implementation of international agreements, enforcement	Cost of administrating and enforcing agreements and project management No. of infringements and sanctions	Characteristics of formal and informal authorities Quality of bureaucracy Contract enforceability
Information sharing	Institutions, markets, formal and informal networks	New institutions created No of institutional units participating in policy implementation (companies, households, public sector, NGOs, individuals)	Description of networks; members, roles, interests
Equity	Distribution of costs and benefits, income distribution, local participation	Cost and benefits in economic units related to stakeholders, income segments, gender, geographical area etc. Income generation adjusted with distributional weights Gini coefficient	Mapping local stakeholders and their participation Gender aspects
Poverty alleviation	Income or capabilities created for poor people	Change in the number of people below poverty limit, income created to poor people Energy services provided to poor people (energy units)	Characteristics of poverty in terms of limited capabilities: Food, education, health, and limited freedom of choice
Education	Literacy rates, primary and secondary education Training	Literacy rates, enrolment rates, energy for education, time savings from reduced fuelwood collection used for education Changes in years of training	
Health	Life expectancy, Infant mortality, Major diseases, Nutrition	Epidemics, nutrition, energy for clinics, no. of sick days,	

Secondly, as the number of references given above indicates, a comprehensive list of indicators covering all relevant project and SD aspects will almost inevitably be too long for any program to have as a core group of indicators to be evaluated. This is also the case for the indicators listed in Table 6.1. A suggestion is accordingly for a host country to select a **core** set of indicators, which all projects must look at and a **secondary** set, which may be used depending on project details and design. This corresponds to the desirable properties of a set of indicators addressed above that the set should be comprehensive and complete, but at the same time minimal and decomposable. A suggested list of core indicators is provided below in Table 6.2.

Table 6.2: Proposed Short List for Core Indicators

Indicator in CDM Context (With and Without Project)
Energy intensity in sector where investment is made
Energy use per unit of output in project
Energy consumption per capita in affected group
Environmental health benefits (reductions in morbidity rates)
Income inequality and poverty in affected group
No. of man-years created or lost
Emissions of air pollutants
Emissions of GHGs
Generation of solid waste
Intensity of use of forest resources as fuelwood
Rate of deforestation
Mortality rates in affected area

A third comment is that in most cases it will be necessary for the CDM process to consider a number of qualitative indicators in addition to the quantitative indicators. Qualitative indicators are needed to capture impacts that are important and cannot be quantified, such as impacts on institutions, networks, etc., resulting from the project. As these examples and Table 6.1 suggest, particularly the social dimension of sustainability is an area, where a combination of qualitative and quantitative information is usually required. The use of this combined information requires careful consideration with regard to comprehensiveness, consistency, and transparency in definition and presentation. Furthermore, the provision of information about social sustainability dimensions is complicated by the relatively premature state of the research and applications in this area compared with other aspects. In practice, it will be difficult to collect and interpret all the suggested information for individual policies and comparable policy assessments.

A fourth and final comment is that the impacts of the project are always compared to a baseline case. In relation to the tables above, this implies that we are interested in the changes in the measurement standard of the indicators between the baseline case and the CDM project case.

Table 6.3 Illustrative example of a qualitative assessment of the SD impacts of introducing a biogas plant to substitute woodfuel and kerosene consumption

	Project costs	Energy access and affordability	Employment
Baseline case: Woodfuel for cooking and kerosene for lighting	Replacement costs of woodfuel cooking devices and kerosene lamps	High costs of woodfuel and kerosene	Employment related to woodfuel and kerosene provision
CDM project: Biogas plant for electricity production	Capital costs of biogas plant and cooking and lighting appliances	Low costs of gas and electricity	Employment related to construction phase and maintenance
Net impact of replacing baseline case with CDM project	Probably higher project costs	Lower energy supply costs	Higher employment in project startup but lower permanent employment

6.4 Applying Sustainability Indicators to CDM Projects – An Illustration

To illustrate how SD impacts of a CDM project may be assessed qualitatively in practice, the following hypothetical case example is constructed. The hypothetical CDM project considered is a rural biogas plant for household cooking, lighting, and electricity production. The project is assumed to replace a baseline activity, where cooking and heating is based on woodfuel and kerosene is used for lighting. Table 6.3 gives an overview of the impacts of the case example CDM project compared to the baseline activity.

No attempt has been made to quantify the indicators that have been chosen to assess the SD impacts of the project and in this sense Table 6.3 presents a qualitative overview of the SD impacts. Furthermore, it is emphasised that the specific indicators of SD impacts of the CDM project should merely be seen as examples of indicators that countries may decide to consider.

The qualitative assessment of SD impacts illustrated in Table 6.3 represents costs, energy access and affordability, employment, local and global environment, education and income generation. The assessment suggests that in most of these

Environmental impacts	Education	Income generation
High local air pollution with associated health damages	Energy provision takes time from educational activities Lighting quality poor for studying	No power supply for local industry Households spend time on energy provision that substitutes income generation activities
Low local air pollution with associated health benefits and less deforestation.	Better lighting for studying	Energy supply supports development of local industry Households get more time for income generation activities
Lower air pollution with associated health benefits	More time for education and better lighting facilities	More income generated

areas, the biogas project will have positive impacts compared with the baseline of woodfuel and kerosene consumption.

However, the project may imply that income generation and employment of people related to the woodfuel and kerosene consumption will experience a decrease in activity. It is therefore important to consider how the people affected may benefit from being integrated in the establishing of the biogas plant or in business activities generated by the improved energy access. Another possibility for getting more local development benefits out of this particular CDM project is to try to supplement the specific CDM project with an additional CDM project that creates employment opportunities for the people who are loosing their job in relation to the reduced woodfuel and kerosene supply. This options corresponds to the sustainability rule of a shadow project constraint, discussed in chapter 4. Examples of CDM projects with positive employment impact are plantation or agricultural projects and various energy projects that include construction work.

Most CDM projects in the energy sector will create multiple positive side impacts on SD indicators as the ones listed in Table 6.3. As just shown, however, there may be examples of projects with some negative impacts; for example a negative employment impact in cases where labour-intensive fuel consumption is substituted. While in general CDM projects generate positive SD impacts, cases such as the one just cited are not uncommon. For example, GHG emissions reductions mostly result in an improvement in air quality, but a counterexample is the case where diesel is substituted for gasoline in the transport sector. Diesel consumption has lower GHG emissions per km than gasoline, but have higher local air emissions. In Chapter 8 further discussion and illustration of the positive and negative SD impacts of CDM projects is provided.

6.5 Conclusions

Indicators are necessary for any assessment procedure. In the context of CDM projects, they are needed to provide information about the performance of a given CDM project with respect to the chosen SD criteria.

This chapter has outlined a number of desirable properties of (a set of) SD indicators for CDM projects. As a starting point, the indicators should be chosen so that they are comprehensive, i.e. cover the all the SD criteria chosen for the three dimensions of sustainability and provide the decision maker with sufficient knowledge to assess the extent to which a given SD objective has been reached, and measurable, i.e. the indicator can be defined and measured unambiguously and without excessive use of effort, time and costs. Other desirable properties of a set of indicators for assessing SD impacts relate to completeness, operationality, decomposability, non-redundancy, and minimalism.

The chapter has demonstrated that a very large number of SD indicators, quantitative as well as qualitative, are available in the literature. It has therefore been suggested to use existing statistical material and measurement standards for the indicators to the extent possible. In most cases it will be necessary for the CDM process to consider a number of qualitative indicators in addition to the quantitative indicators. These qualitative indicators are needed to capture impacts that are important and cannot be quantified, such as impacts on institutions, networks etc resulting from the project. Particularly the social dimension of sustainability is an area, where a combination of qualitative and quantitative information is usually required. The use of this combined information requires careful consideration with regard to comprehensiveness, consistency, and transparency in definition and presentation.

An overview of indicators that may be used to evaluate general economic, environmental, and social sustainability dimensions of CDM projects has been provided and it was pointed out that a comprehensive list of indicators covering all relevant project and SD aspects will almost inevitably be too long for any program to have as a core group of indicators to be evaluated. To handle the process of evaluation, it was suggested to select a core set of indicators, which all projects must look at and a secondary set, which may be used depending on project details and design.

To illustrate how a qualitative assessment can be carried out in practice, a hypothetical case example was constructed. The case example analysis and following discussion suggested that most CDM projects in the energy sector have the potential for creating multiple positive side impacts on SD indicators. The case example, however, also illustrated that there may be examples of projects with some negative impacts or tradeoffs; for example a negative employment impact in cases where labour-intensive fuel consumption is substituted, or a deterioration of local air quality in cases where diesel is substituted for gasoline in the transport sector. In such cases, actions to mitigate the negative impacts are called for and the chapter outlined some possibilities for doing this, including re-designing the CDM project in order to mitigate any negative impacts, or supplementing the specific CDM project with an additional CDM project that creates positive SD impacts to offset the negative impacts of the original project.

6.6 References

Keeney, R. L. and H. Raiffa (1993), ***Decisions with Multiple Objectives. Preferences and Value Tradeoffs.*** Cambridge University Press, Cambridge.

7 Decision-Making Tools for SD Evaluation of CDM Projects

There are a number of tools that can be used to assess the sustainable development impacts of CDM projects. These include cost-effectiveness analysis, cost-benefit analysis, multi-criteria analysis and ranking methodologies. These involve different levels of analytical complexity and each can be carried out in a simple way or in a more complex way. This section reviews the key advantages and disadvantages of each technique that may be employed by the host country to identify the sustainable development benefits resulting from CDM projects.

7.1 Cost Effectiveness Analysis (CEA)

Cost-effectiveness analysis involves a direct examination of the costs of mitigation options against the potential reductions, and provides for a ranking of projects on that basis. The basic calculation involves estimating the costs in each year of the project and 'adding up' these costs to arrive at a "Present Value' figure (PV). The PV is not a simple sum of the annual costs but one where future costs are **discounted.** Thus a cost in five years time of €100, will equal in present value terms, at a discount rate of 10 percent, Ð62 (i.e. $100/(1.1)^5$). This PV cost is then divided by the reduction in GHG emissions, measured in comparable units, to arrive at a cost per ton of GHG reduced. Naturally, the lower this cost, the more cost effective is the project. Calculating this cost effective measure for each of a number of projects allows us to rank them in order of the cost per ton of GHG reduced.

Any investors in a CDM project will carry out some kind of CEA analysis, so that they can evaluate how much they are implicitly 'paying' for any carbon credits they receive. Likewise, host country will want to know how much the carbon reductions are costing the investor, relative to the market price for such credits. Consequently a CEA analysis, at least in a simple form, is almost always a component of any CDM project. It is particularly useful when comparing different GHG mitigation projects.

Although relatively simple, the method has a number of features that need attention if incorrect or misleading results are to be avoided. The first is to establish the 'baseline' – i.e. what would have happened to emissions in the absence of the project. This can be quite complex, as it involves predicted the future without the project. Second, the costs of the project itself are not always straightforward. Taxes and subsidies drive a wedge between financial and 'economic' costs and both are relevant to an evaluation of the project. This chapter does not go into detail about the costing method (see IPCC, 2001, Chapter 7, for more details), but draws attention to the fact that care is needed in measuring the costs.

7.2 Cost Benefit Analysis

The cost benefit approach is one where all the project's costs are estimated in present value terms along with all the projects benefits in similar terms, and a net benefit is calculated. The difference between the PV of benefits and the PV of costs is called the net PV (NPV) of the project. If this is positive, the project is considered to have 'passed' the economic test. Another way in which the net benefits of the project can be reported is by calculating the discount rate at which the NPV would be zero. This is called the 'internal rate of return' of the project (IRR), and if it exceeds the test discount rate the project passes the economic test.

Of course the costs and benefits are not certain, and one may obtain a range of PV values for each, giving in turn a range for the NPV. If part of the range is negative, the project does not automatically pass the economic test, and other factors have to be considered.

In applying this method to CDM projects one difference from the usual benefit cost analysis is that **no** account is taken of the benefits of the reduction in carbon resulting from the project. The net benefit of the project simply reports the NPV without the carbon benefits and then these benefits are assessed separately. For example, if the NPV is negative, one can ask what minimum value per ton of do we need to switch the NPV value from negative to positive? This critical value can then be compared with the likely price at which carbon reductions can be sold, to see whether the project is now economically justifiable. Hence the carbon valuation is a second part of the appraisal of the project[10].

The key aspects of any CBA are that the costs and benefits are measured in economic terms. This may mean they have to be adjusted from their monetary values, where the latter are available. Furthermore, where no such values are readily available from market or financial data, estimates have to be made. This is frequently the case for 'externalities' – i.e. impacts that do not act through a market transaction. For example, a reduction in GHGs may cause a fall in other pollutants, and this reduction has a value, which is not expressed in any monetary transaction.

The basis of the economic valuation in any CBA is normally the willingness of any individual to pay (WTP) for a good or service, or to accept payment for forsaking the use of a good or service (WTA). It can be shown that a WTP/WTA valuation is what market data provide when the markets work efficiently and competitively. When this is not the case, market data have to be adjusted to obtain these economic values.

A CBA normally aims for what is called a **social cost assessment**. This includes all costs and benefits of a project, including impacts that occur to private agents that

10 No discount rate is applied to the carbon reductions in calculating the critical price. Given the low rates used for this purpose, it will make little difference to the conclusions and the issue is controversial anyway..

are directly involved in the project implementation as well as impacts on others of his or her actions (the externality costs). They also include operation costs, planning and training and other implementation expenditures that are needed to get a GHG emission reduction project into operation.

Markandya and Halsnaes (2002) presents a further development of a methodological framework for the assessment of indirect costs and benefits developed by Markandya, 1998 as part of the UNEP project Economics of GHG Limitations. The specific indirect costs and benefits that have been included in the social cost assessment are:

- Employment impacts.
- Health impacts.
- Associated environmental changes.

These different impacts can be quantified and placed in monetary terms, allowing for cost-benefit analysis of different policy options.

Some argue that cost-benefit analysis may be appropriate for calculating the overall benefits of the CDM program but not for individual projects, owing to the time, costs and lack of transparency offered by the CBA framework (see, for example, Thomas et al, 2002). However, CBA is a commonly applied methodology for assessing project level impacts and though it may not be as appropriate for small scale projects due to the cost factor, for larger CDM projects a CBA-type assessment method may be readily applied.

7.3 Multicriteria Analysis

Multicriteria analysis (MCA) is a useful tool where there is a decision to be made based on different types of information, all of which is relevant to a decision about the project but which cannot all be collapsed into a single measure like a NPV or an IRR. The different categories of information lead to multiple criteria, each of which is converted into a measure of those criteria. This is easy when the information is quantitative, but can also be done for qualitative information. The basic steps in conducting a MCA (which is occasionally referred to as MCDA or multi-criteria decision analysis in the literature) are as follows (based on DTLR, 2000):

1. Establish the decision context – defining the aims of the analysis and who the decision makers are
2. Identify options for CDM projects
3. Identify objectives and criteria to reflect value of consequences of options
4. Describe effectiveness of each option under the different criteria
5. Weighting of decision criteria to reflect relative importance to the decision

6. Combine weights and scores to obtain overall value of option
7. Examine results
8. Conduct a sensitivity analysis of the results to assess how sensitive results are to changes in key values/weights.

This technique has been widely used in the literature assessing the sustainability implications of climate change mitigation options. One outcome of a MCA (Step 4 above) is a matrix of policy options and impacts, such as that derived for a study for Brazil shown as in Table 7.1 below. In this case the entries are qualitative, and for a full MCDA they would have to be converted into some quantitative estimates so that stages 5-8 could be conducted. The main objective in presenting the information regarding sustainability in this way is to enable transparency in the evaluation of options, and by doing so to better facilitate policy makers in their decision-making process. The below table identifies the environmental, development and equity impacts of four options: ethanol, cogeneration, biomass and wind energy. The transferability of environmental, development and equity impacts is to some extent site-dependent, but in general the environmental impacts identified below would apply to the technology rather than to the site. One area of concern in terms of the environment and location would be that of biodiversity.

7.4 Ranking Methodologies

A number of different methodologies have been proposed in the literature to "rank" sustainability outcomes of CDM projects. These involve either simple "checklist" approaches or more complex baseline and best practice approaches. These may supplement the multi-criteria assessment shown above and be used to weight the relevant criteria. The relative merits of these measures are discussed below.

7.4.1 Checklist or Positive List Approach

Thomas et al (2000) propose a "checklist" based approach, following the identification and prioritisation of sustainable development objectives within the CDM context. This is proposed in order to reduce the deterrent effect that the sustainability requirement may have on the implementation of CDM projects, and to reduce costs.

A checklist of indicators would be drawn up based on the indicators felt to be important to ensure sustainable development from CDM projects. Projects would then be ranked negative, positive or neutral against these indicators, with overall sustainability being shown by an overall positive rating. This is clearly a simplistic methodology, and has some clear advantages in terms of transparency, though the proposed sustainability measure may prove to be hard to justify in some cases, hence weights might be needed to assure the compliance of a measure with the national SD objectives. In section 8.2, we return to the checklist approach and provide some examples of its application.

Table 7.1 MCA of policy options

	Ethanol (with Bagasse Co-generation)	Cogeneration from Refineries	Biomass Thermo electricity (gasification of wood)	Wind Energy
Environmental Impacts				
Effects on Water Resources Availability	negative low	not relevant	Negative low	not relevant
Effects on Water Resources Quality	negative medium	not relevant	negative low	not relevant
Effects on Urban Air Pollution	positive low	positive medium	negative uncertain	Positive high
Effects on Soil Erosion	negative medium	not relevant	negative uncertain	not relevant
Effects on Biodiversity Protection	uncertain	not relevant	positive low	not relevant
Secondary Benefits				
Development Impacts				
Effects on Aggregate Demand	positive high	positive low	positive medium	Positive low
Effects on Trade Balance	positive high	positive high	positive high	Positive low
Effects on Regional Economy	positive very high	positive low	positive high	Positive medium
Opportunity cost of the output foregone	positive low	neutral	positive low	Neutral
Equity Impacts				
Effects on income distribution based on the project's unskilled labor participation	positive high	neutral	positive low	Neutral
Effects on the consumption of the project's output by income class	negative medium	neutral	positive low	Neutral
Effects on the distribution of environmental benefits by income classes	positive high	positive medium	positive low	Positive medium

Note: Grey box shows "best option" for indicator of sustainable development impact in cases where a positive impact is present.
Source: Markandya and Halsnaes (2002)

A positive list approach would involve the identification of project types that are automatically considered compatible with CDM criteria, following Kelly and Helme (2000). Thomas et al (2000) recommend that "this list would not be exclusive but projects not included on the list would come under a more rigorous reviews to assess compatibility with national sustainable development priorities".

7.4.2 *"Baseline and Best Practice Approach"*

Heuberger and Sutter (2002) propose that the assessment of the sustainable development implications of CDM projects should be based on the comparison of the SD impacts of the baseline project used to assess the CERs attributable to the CDM project in question. Heuberger and Sutter propose a methodology of scaling the different qualitative and quantitative indicators to a basis of indicators ranging from -1 to +1 where -1 indicates a strongly negative impact of the project on the indicator in question and +1 indicates a strongly positive impact. An example may be that of a CDM energy project, which may have as the baseline a modern coal-fired plant that would otherwise be built. The indicators would be compared for each project against the baseline.

This methodology is appealing in terms of simplicity, though the transparency and comparability of the indicators is questionable. A full multi-criteria assessment would provide similar results but be more transparent for policy-makers in the view of the authors, and where possible an assessment of the monetary or monetary-equivalent benefits of CDM projects should be derived to allow for best practice in policy formation and assessment of project implications on sustainable development by the host country.

7.4.3 *Analytical Hierarchy Process*

The Analytical Hierarchy Process provides a tool for scoring and weighting of non-quantifiable attributes of a mitigation option. In its standard form, the AHP uses procedures for deriving the weights and the scores achieved by alternatives, which are based on pair wise comparisons between criteria and between options. Thus, for example, in assessing weights, the decision maker is asked a series of questions, to assess the importance of criteria and, from the answers, weights are derived for which are then applied to the values of the criteria.

While not providing single answers, the AHP results reveal which projects will be preferred under different preferences and how rankings would change if certain criteria were to be given more weight. It may lend transparency and structure to project evaluation and decision-making. This process was applied in one case study for India in Markandya and Halsnaes (2002), leading to the weights shown in Table 7.2 for different impacts (both quantitative and qualitative). The results of applying this methodology are presented in Table 7.2 (which gives the weights) and Table 7.3 (which gives the rankings) both by the CEA criterion of the price per ton of carbon and by the more complex MCA criteria as developed by the AHP method.

Table 7.2 AHP weights derived from Indian case study

Main criteria	Relative weights (as percentage of total weighting)	Sub-criteria	Relative weights (as percentage contribution to main category)
Incremental cost effectiveness ($/tC)	7.5		
Feasibility	39.4	Government policy	42.9
		Compromising socio-economic development.	42.9
		Risk	14.3
Other Environmental Benefits (non CO2)	13.7	Resource conservation	42.9
		Decrease in pollution loading	14.3
		Health	42.9
Development	39.4	Employment generation	25.8
		Value addition	10.5
		Rural development	63.7

Source: Markandya and Halsnaes (2002)

Table 7.3 Summary of sector rankings and carbon price

	Carbon Price ($/ton of carbon)	Ranking by carbon price	Ranking by AHP
Conventional Power Generation			
Bagasse based cogeneration	-244.1	1	1
Combined cycle generation (Natural gas)	-133	2	2
Atmospheric fluidized bed combustion	7	3	5
Pressurised fluidized bed combustion	47	4	4
Pulverized coal super-critical boilers	96	5	6
Integrated gasification combined cycle	96	5	3
Renewables for Power Generation			
Small hydro	29	1	2
Biomass Power	134	2	1
Wind farm	216	3	3
Photovoltaic	1306	4	4
Renewables for Agriculture			
Wood-waste based gasifiers	169	1	1
Agro-waste based gasifiers	177	2	2
Wind shallow well	298	3	5
Wind deep well	329	4	4
PV pump	6333	5	3
Cement			
Dry suspension preheater kilns	7	1	1
Dry precalciner kilns	214	2	2

Source: Markandya and Halsnaes (2002)

7.5 Conclusions

This chapter has presented an overview of different decision-making frameworks and identified the key advantages and disadvantages of each technique.

Below, Table 7.4 summarises the options in terms of the three main criteria. It is important to note that these techniques are not mutually exclusive in their application. As noticed in the beginning of the chapter, CEA is almost always carried out in order to provide a comparison of the financial and economic impacts of projects. For a more detailed assessment, as for example related to the assessment of SD impacts of CDM projects, a CBA may then be performed and inputs from the CEA can be used for this purpose. Furthermore, a CBA may act as an input into multi-criteria analysis.

The decision-making tool applied could have a critical effect on the decision, so it is important that the analyst consider carefully the frameworks that are applied. Cost-benefit analysis may be most appropriate for large-scale projects and for developing an overall assessment of the social costs and benefits of a portfolio of CDM projects. MCA is appealing as it allows comparison of qualitative and quantitative data within a single framework, whilst ranking adds to this by allowing the assessment of priorities by different stakeholders or policy makers to explicitly enter the decision-making framework.

Table 7.4 Comparison of different decision-making frameworks

	CBA	Cost Effectiveness Analysis.	MCA
Selection of variables for investigation	Based on welfare concepts – e.g. defined to reflect policy priorities.	Partly based on welfare concepts – e.g. defined to reflect policy priorities.	Indicators representing policy priorities.
Standard for measurement of variables	Welfare, eventually in monetary units.	Cost minimization, eventually in monetary units. GHG emissions in physical units or other policy goals.	Quantitative and/or qualitative units.
Weighting rules	Individual preferences as stated on markets.	Individual preferences as stated on markets.	Alternatives: no weighting. preferences of policy makers. broader policy process.
Preference function	Maximise welfare.	Minimise costs of achieving a target reduction of GHG.	Total score on indicators if weighting rules are applied. Individual indicators. Sensitivity analysis. Tradeoff analysis.

7.6 References

Heuberger, R. and C. Sutter (2002), ***Submissions to CDM Connect Discussions.*** Available online at www.cdm-connect.org.

IPCC (2001), ***Costing Methodologies***, in B. Metz, O. Davidson, R. Swart and J Pan (eds.) Climate Change 2001: Mitigation. Cambridge University Press.

Kelly, C. and N. Helme (2000), ***Ensuring CDM Project Compatibility with Sustainable Development Goals.*** CDM Dialogue series paper. Available from http://www.ccap.org

Markandya, A. and K. Halsnaes (2002), ***Climate Change and Sustainable Development. Prospects for developing countries.*** Earthscan, London.

Thomas, F., Ulrich, S. and C. Schlenzig (2000), ***Ranking Methodologies for Sustainable Development and CDM Project Checklists.*** Working Paper, available online at http://cdmsusac.energyprojects.net/Links/general_docs/ranking_methods_for_sd.pdf.

8 CDM and Sustainable Development: Case Studies

8.1 Introduction

In this chapter, we present a number of case studies to illustrate how the issues raised in the previous chapters of the guideline can be and have been addressed in formal CDM project SD evaluation. The purpose is to provide practical examples of actual choices regarding SD criteria, indicators and decision-making tools.

Case studies involving three types of decision-making tools introduced in the previous chapter are discussed: the checklist approach (section 8.2), MCA (section 8.3), and CEA (section 8.4). Finally, in section 8.5, some general conclusions are made. The CEA type of analysis has been given more emphasis in terms of number of pages, since we what to illustrate how it can be extended to cover aspects from all dimensions of SD and we have not found examples of this type of analysis in the existing literature. By contrast, examples of the two other types of SD evaluation of CDM projects are more readily available.

As we have noted earlier in these guidelines, the screening of CDM projects should preferably result in a list of potential projects that exploit and maximise synergies between GHG emission reductions, national SD objectives, and project investors' perspectives. In practice this implies that the project's financial costs per ton of CO_2 equivalent reduced will always be an important indicator and as such should always be calculated for each project.

As will be apparent, there is a considerable degree of convergence regarding general SD criteria across the case studies. The main differences arise from the way in which the SD criteria are transformed into the basis for decision-making, i.e. in the construction of indicators and in the procedures for comparing and weighting the indicators.

8.2 Case studies: The Checklist Approach

8.2.1 The SSN Matrix Tool

The international NGO SouthSouthNorth (SSN) has developed a commonly referred to and used checklist tool for appraising the suitability of proposed CDM projects. The tool is called the SSN Matrix Tool and it consists of eligibility criteria, additionality filters, sustainable development indicators, and feasibility indicators. Here we will concentrate on the SD indicators, of which an overview is provided in Table 8.1 below[11]. A detailed list of the latest version of the tool can be found in Annex A.

Table 8.1 SD indicators of the SSN matrix tool

Indicator	Measurement
Local/regional/global environment	
GHG emissions	Tons of CO2 equivalent.
Water quantity and quality	Water quantity: number of people with access to water supply Water quality: concentration of main pollutants (including BOD and others)
Local air quality	Tons of SOx, NOx, particulate matters etc.
Other pollutants	Pollutants not already considered to the environment, including solid, liquid and gaseous wastes.
Soil condition (quality and quantity)	Concentration of most relevant soil pollutants, erosion and the extent of land use changes.
Biodiversity	Destruction or alteration of natural habitat and species
Social sustainability and development	
Employment (qualitative)	Highly or poorly qualified, temporary or permanent.
Livelihoods of the poor	- Poverty alleviation: Change in number of people living above income poverty line - Distributional equity: Changes in income and improved opportunities - Access to services: water, health, education, access to facilities, etc. - Access to energy services: Coverage of reliable and affordable clean energy services, security of energy supply - Human and institutional capacity: a. Empowerment; access of local people to and their participation in community institutions and decision-making processes. b. Effects on education and skills. c. Gender equality; empowerment, education/skills and livelihoods of women
Economic and technological development	
Employment	Net employment generation
Balance of payments	Net foreign currency requirements
Technological self reliance	Replicability, hard currency liability, skills development, technology transfer

A project's performance is assessed against the list of indicators presented in Table 8.1, using the following scoring system (SSN 2003):

-2: major negative impacts, i.e. where there is significant damage to ecological, social and/or economic systems that cannot be mitigated through preventive (not remedial) measures.

-1: very minor negative impacts, i.e. where there is a measurable impact but not one that is considered by stakeholders to mitigate against the implementation of the project activity or cause significant damage to ecological, social and/or economic systems.

---

11 For a full description of the approach, see e.g. SSN 2003 or Thorne and Raubenheimer 2001. A closely related tool is the so-called 'gold standard' adopted by WWF (see e.g. www.panda.org/goldstandard). To meet the requirements of the Gold Standard, each of the components in . Table 8.1 must have a sub-total score that is non-negative, the total score must be positive, and if one of the indicators has a score of -2, the project is not eligible for the Gold Standard.

0: no, or negligible impacts.
+1: minor positive impacts
+2: major positive impacts

All changes are to be considered relative to the baseline situation (i.e. without the proposed project), each sub-total must score better than –1, and each indicator must score better than –2.

As is seen from Table 8.1, the SSN matrix tool can be placed somewhere on the border between a checklist approach and a MCA. The scoring system includes numbers (rather than just a statement such as positive, neutral, negative), implying that the scores can be and indeed are being combined to obtain a total score for a given project. No weights are assigned, implying that all main indicators have equal weight.

It is also seen that a large number of SD indicators are included in the assessment tool and while this is partly a result of the coverage of all major areas of SD impacts, it will probably be difficult to provide information on all relevant indicators for all projects. Another immediate issue is that given the bias towards the use of qualitative indicators, the application of scores will involve a rather high degree of subjectivity. In relation to the guidance provided in chapter 6 on the selection of indicators, the SSN matrix tool can be said to fulfil the desirable properties of comprehensiveness and completeness, whereas it is not entirely unproblematic when it comes to measurability and operationality as well as in terms of the desirability of keeping the set of indicators minimal.

8.2.2 Application of the SSN Matrix Tool – Two Case Studies

The SSN matrix tool has been applied to projects in Bangladesh, Indonesia, South Africa, and Brazil. Here, we have included two case studies: The Mondi Richards Bay Biomass Project (South Africa) and the Biodiesel Production for Use in the Transport Sector project (Brazil). A summary of the two case studies is given in Table 8.2 below, followed by sustainability assessment tables for the two projects[12]. It should be noted that the sustainability assessment tables are based on a previous scoring system going from –3 to +3, which is why these numbers appear in the tables. Furthermore, the tables include the main indicators only. For this reasons, the sustainability assessment tables do not exactly correspond to Table 8.1 above. The full version of the criteria and indicators appraisal matrix that the present two projects are based on is provided in the Annex to this chapter.

12 The full project documents can be downloaded from http://www.southsouthnorth.org/.

Table 8.2 Overview of SSN matrix tool case studies

PROJECT	DESCRIPTION
South Africa: Mondi Richards Bay Biomass Project	This project activity proposes to recover the biomass waste, which is currently being land filled to use as a renewable energy resource in biomass boilers thereby reducing both coal consumption and all other CO_2 emissions. Also, the proposed biomass boiler to be utilised will be able to accommodate a further 170 tonnes per day which the currently used coal boiler cannot carry. Reduction in CO_2 emissions is estimated at 64,855 tons annually with a crediting period of 10 years, amounting to a total reduction of emissions of 703,690 tons of CO_2. The proposed main project activity has two activities: a. Recovery of biomass waste that consists of fines, wood chips, and logs presently being land filled at a Richards Bay Municipal Landfill site and b. Usage of the biomass waste in an extended biomass power boiler as an alternative fuel for the generation of steam at Mondi Kraft (Richards Bay) for the production of pulp and linerboard. In order for the project to be cost-effective, the carbon credit needs to be included. As no economic calculations are provided in the public domain, further information regarding the financial analysis of the project is not possible.
Brazil: Biodiesel Production for Use in the Transport Sector	This project is designed to partially replace fossil fuel (diesel oil) by biodiesel in the transportation sector. Biodiesel is a methyl ester obtained through transesterization and in this project it is produced from used vegetable (cooking) oils. The use of biodiesel avoids approx. 34,918 tons of CO_2 equivalent emissions over its ten-year crediting period. The avoided emissions that would occur without this Project Activity are obtained through the renewable CO_2 biodiesel burning cycle that replaces the non-renewable CO_2 cycle based on fossil fuel, according to the Baseline described below. Also considered are the GHG emissions due to the use of methanol and electricity in biodiesel production, and the emissions from the transportation of the collected waste vegetable oil and of the biodiesel distribution. In order for the project to be cost-effective, the carbon credit needs to be included.

It is seen from Table 8.2 that the projects cover energy efficiency and transport and that the Mondi Richards Bay project involves approximately 20 times higher CO_2 equivalent emissions reductions than the Biodiesel production project. It should also be noted that in both cases, the carbon credits are needed in order for the projects to be cost-effective. As other economic data was not readily available for both projects, no further economic analysis is provided. The sustainability assessment for Mondi Richards Bay biomass project is given in Table 8.3, below.

Table 8.3 Sustainability assessment for Mondi Richards Bay biomass project

Sustainability Indicators	Score	Comments
Indicator 1 - Contribution to the mitigation of Global Climate Change	3	Against a baseline the estimated reduction of emissions are approximately 703,690 tons CO2
Indicator 2 - Contribution to local environmental sustainability	3	The improvement in local air quality by reducing SO2 and NOx emissions from coal as the consumption of coal is reduced by replacement by biomass. In the Richards Bay area there will be a reduction in methane emissions from landfill due to a reduction in the amount of biomass landfilled.
Indicator 3 - Contribution to net employment generation	1	There will be a minimal increase in employment due to construction and commissioning the systems, as well in the supply of the additional transport needs. This will occur specifically in the small-medium to medium sized Enterprises (SMME).
Indicator 4 - Contribution to the sustainability of the balance of payments	1	For both project activities, local technology will be used.
Indicator 5 - Contribution to macroeconomic sustainability	1	There will be no impact on national imports or exports. Minor impact expected on regional import of coal to the KZN area as the amount of coal reduction compared to the total amount of coal transported by rail from other regions is small. The project activity will also result in more efficient production processes at Mondi.
Indicator 6 – Cost Effectiveness	2	The project is only cost-effective if the carbon financing is included. In such a case the internal rate of return makes the project cost effective for the project participant to finance.
Indicator 7 - Contribution to technological self-reliance	0	Technological self-reliance stays similar to the baseline case. Some additional electricity has to be imported from the national grid but is offset by the reduced amount of coal that has to be imported from other regions by rail. Biomass is accessible locally.
Indicator 8 - Contribution to the sustainable use of natural resources	2	Energy efficiency improvement and the use of renewable energy reduce the use of natural resources.

Not counting the contribution to the mitigation of global climate change, the project scores a total of 10 out of a maximum of 24, indicating that the project will have a positive contribution towards sustainable development. A small remark is that it may be considered somewhat strange, that the project can get a score of 2 on cost-effectiveness, when it is only cost-effective if carbon credits are included. It is noticed that the main SD impacts of the project are in the environmental dimension of sustainability.

The Brazilian **biodiesel production for the use in the transport sector** project scores a 10 (including the contribution to the mitigation of global CC) out of a total of 24 in the sustainability assessment, which can be seen from Table 8.4 below.

Table 8.4 Sustainability assessment for biodiesel production for use in the transport sector project

Sustainability Indicators	Grade	Justification
Indicator 1 - Contribution to the mitigation of Global Climate Change	2	90% reduction in greenhouse gas emissions.
Indicator 2 - Contribution to local environmental sustainability	1	The significance to local sustainability refers to the 98% reduction of SOx and 50% of particulate material emissions. On the other hand, there is a 13% increase in the emission of NOx, an ozone precursor that causes photochemical smog.
Indicator 3 - Contribution to net employment generation	1	The generation of new jobs in the metropolitan region is proportional to the increase in the collected used oil, going from 500 cubic meters a month to 628 cubic meters.
Indicator 4 – Distributive Impact of the Project	0	The output of the project does not change the living conditions of the low-income population.
Indicator 5 - Contribution to the sustainability of the balance of payments	1	Since Brazilian diesel oil imports amount to 4 billion liters a year and another 8 billion are refined here with imported petroleum, corresponding to 33% of the national consumption, it can be assumed that one liter of this fuel contains this percentage of imported material. Since biodiesel replaces 90% of diesel oil, this factor will correspond to 30%.
Indicator 6 - Contribution to macroeconomic sustainability	2	Since 96.5% of diesel oil imports in 2002 were carried out by Petrobras, a public company, this means that biodiesel production will increase macroeconomic sustainability
Indicator 7 - Contribution to technological self-reliance	1	Biodiesel will be produced with domestic technology. The rate of nationalization of the equipment used in oil production and in obtaining diesel oil is about 70%.
Indicator 8 - Replicability and regional integration	2	Possible to replicate in large cities. May encourage the expansion of actions by cooperatives, increasing the number of used oil collectors.
Total	10	

Compared with the Mondi Richards Bay project, the SD indicators included in the assessment of the Biodiesel project suggests that this type of project may have broader effects on the economy. This is indicated in the possibility of replication and regional integration as well as in larger impacts on the macroeconomic sustainability indicator.

All in all, the SSN matrix tool provides a systematic approach to SD assessment of CDM projects and information on SD impacts that is useful when it is combined with data regarding the project cost per ton of GHG abated.

8.3 Case studies: The MCA approach

8.3.1 The Egypt National Strategy Study Setup

In this section, we have taken case studies from the Arab Republic of Egypt's National Strategy Study (NSS) on the CDM (Egypt NSS 2002) to illustrate how MCA may be used to assess the SD impacts of CDM projects. In the study, all sectors of the economy were covered and screened for suitable projects, focussing on those with the highest GHG emission reduction potential, i.e. energy generation, renewable energy applications, transportation, energy efficiency in industry, and LULUCF (i.e. land use, land use change and forestry). On the basis of this screening, an initial portfolio of 22 projects was selected. A cost calculation was carried out for all the selected projects, providing information on marginal abatement cost (MAC), the cost of saved carbon, GHG reduction potential, and the expected payback period. Following this, each project was assessed on a proposed set of national SD criteria covering economic, environmental, and social dimensions, as well as on a set of criteria from the perspective of international investors.

Based on the outcome of the assessment, 7 projects were selected for the CDM pipeline in Egypt. The proposed sets of criteria and rules for weighting are listed below in Table 8.5.

The justification for including a set of indicators reflecting investors' perspective is that investors usually look very differently at potential projects and by taking this view into account, it is possible to select a portfolio of potential projects that simultaneously are of high national interest and of high interest for potential international investors. While it clearly makes little sense to develop a portfolio of projects that are of no interest to potential international investors, the respective weights assigned to national SD criteria and investors' criteria (in this case 110 and 70 respectively) are open to question. The set of indicators reflecting investors' interests is included here, but naturally it is possible to look at the SD criteria only.

Table 8.5 Overview of egypt NSS SD criteria, indicators and weights

	Criteria Indicators	Allocated Weight	Grade + L	M	H	Score ++ (Weight * Grade)	Range
1	Economic	(80)					
1.01	Infrastructure	10					L= replacing, M= expanding, H= creating
1.02	Export Potential/ import substitution	10					L ≤ 15%, 15%<M≤35%, H >35% of Annual production
1.03	Payback period	30					L >8 or no payback, 5<M≤ 8, 2<H≤5 years
1.04	Energy savings	20					L ≤ 10 %, 10% < M ≤15%, H> 15% TOE/year of BAU
1.05	State of technology	10					L= Commercially available, M = modern technology, H= advanced technology
2	Environmental	(20)					
2.01	Improvement in environmental performance	20					L= comply with Egyptian legislation, M= comply with annex I countries legislation, H = significantly better than annex I countries legislation
3	**Social**	**(10)**					
3.01	Employment	10					L = job reduction by project, M= no significant change in number of jobs, H= significant creation of jobs
	Subtotal	**110**					

\+ L= 0, M= 1, H= 2 ++ Maximum Subtotal score = 220

4	**Criteria from International Investors' View**						
4.01	Profitability	20					L= no return or loss on investment, M= return on investment ≤ 6%, H= ROI > 6%
4.02	Investor Image	20					L= project might contribute to a negative image of the investor or has no impact on image at all, M= impact of project on investors image is slightly positive, H= is very positive
4.03	Project risk	30					L<50%, 50%<M≤90%, H >90% of the probability of the generation of the expected CERs
	Subtotal	**70**					

\+ L= 0, M= 1, H= 2 ++ Maximum Subtotal score = 140

	Total	**180**

\+ L= 0, M= 1, H= 2 ++ Maximum total score = 360

Table 8.5 shows that only two indicators have been included to reflect environmental and social criteria. A suggestion could be to include additional indicators, where possible, on e.g. project impacts on access to energy and poverty/income generation under social criteria and e.g. local air pollution and soil quality impacts under environmental criteria. Furthermore, the present environmental indicator does not take into account the possibility that a project simultaneously could result in e.g. environmental benefits in the form of reduced local air pollution and environmental costs in the form of e.g. reduced water quality. Another point is that the weight allocated to the indicators reflecting the economic dimension of sustainability seems very high: 80 out of a subtotal of 110. Finally, it is noted that compared to the SSN matrix tool, the Egypt NSS provides more firm guidance concerning the application of scores to the individual indicators.

8.3.2 Egypt NSS Case Studies

In the following we have chosen five of the projects that were highly ranked based on the assessment procedure outlined in Table 8.5 to cover CDM options in different areas:

- Energy efficiency projects: Two projects are included, of which one is a cogeneration project of 3.5 MW capacity and one is based on control systems and energy saving equipment.
- Transport project: The project involves installing CNG engines to replace low efficiency diesel in busses.
- Electricity generation project: A 60 MW wind farm in comparison with business as usual (BAU) 45 MW steam turbine.
- LULUCF project: Protecting 10th of Ramadan City by the establishment of forest plantations and shelterbelts.

These projects are summarised in Table 8.6 in the order of their ranking.

Table 8.6 Overview of Egypt NSS case studies

Project	Description and GHG emission reduction	Replication potential	Social and environmental benefits	Risks
Misr Elmonifia Cogeneration (Textile)	Install a gas turbine cogeneration system of a capacity of 3.5 MW and waste heat boiler. The proposed system will cover almost all plant electrical energy requirements as well as part of thermal demand. The hot gases coming out from the gas turbine will be used in production of part of steam demand. The initial investment cost is 1,575,000 US$ and the marginal incremental abatement costs are -237 US $/ ton of Carbon equivalent Base line annual energy is 15,000,000 kWh, 1,162 ton of Solar (fuel # 2) and 1,400,000 m3 of NG. After implementation of the gas turbine cogeneration project it is expected the annual natural gas consumption will be increased by about 5,000,000 m3. The reduction in GHG emission will be achieved by: Produce electrical energy on-site with an efficiency higher than the utility power station, higher than 85%, both thermal and electrical, compared to about 40% for utility power station. Reduce NG consumption in boiler house by about 615,000 m3. As hot gases coming out from the cogeneration system will be used in steam production less amount of fuel is required to produce the same electrical and thermal loads. Therefore, less amount of carbon dioxide will be produced. GHG emission reduction is 911 ton of Carbon equivalent per year	More than 100. As Textile and spinning industry represent a large portion of the Egyptian industry	Add economic value & better environment	Financing.
Control Systems and Energy Saving Equipment at Zenotex Dyers	The project brings the implementation of Measurement & Control Systems and Energy Saving Equipment at Zenotex dyers. The objectives of this project are to improve the effects of energy conservation and reduction in CO_2 emission through installation of measurement & control systems and energy management systems and introduction of energy-saving equipment for the main target equipment involved in dyeing processes (boilers, dyeing machines and dryers) that consume the largest amount of energy in such processes of the textile & dyeing industry – one of Egypt's major industries. The initial investment cost is 1.1 M$ and the marginal incremental abatement costs are -76.2 US $/ ton of Carbon equivalent. GHG emission reduction is 1931.6 tC/y caused by the savings in fossil fuel.	Estimated fuel consumption in textile industry -dying only- (717,000 toe/y) As this CDM project deals with about 5,158 toe/y consumption, It is expected that this will lead to replicability of about 150 small/medium textile dyers.	Cost reduction for companies, quality improvement of the product, reduction of the emission of SO2 and sulfur dioxide	Financing

Install Dedicated CNG Engines to Replace Low Efficiency Diesel Engines	Public Transportation companies (Cairo Transport Authority "CTA" and Greater Cairo Bus Company "GCBC") operate a fleet of 3200 busses in Cairo. The rate of busses entering the service is 200-250 buses per year. The project module is proposing a 100 NG operated bus engines to replace the locally manufactured diesel engines annually. The initial investment cost is 12.3 M$ and the marginal incremental abatement costs are -300.6 $/ ton of Carbon equivalent According to the design data in normal operating conditions, the fuel consumption of the new, local-made diesel engine is 0.65 lit/km. From practical operating conditions at commercial speed about 16 km/h, the fuel consumption is 0.75 lit/km. The current existing laws & regulations enforce the governmental and public sectors to purchase the local production, due to the difficulty of current foreign currency situation. The choice criteria in purchasing are based only on the lower price. The other criteria such as O&M cost, fuel saving cost and its environmental impact are taken into consideration where the prices are equal (law 4/94 for environmental protection puts only limits for the concentration of the emissions and not the amount of the emissions). There is no enforcement for private sector to purchase the low efficiency local-made engines. On the contrary, the companies, which are looking for high quality services and ISO 14000, encourage the CNG engines. The GHG emission reductions of 2580.4 tC/y arise from the replacement of inefficient new local-made diesel engines by CNG engines.	Annually	Saving fuel. Cairo Air Quality Improvement	Financing
Establishment of Forest Plantations and Shelterbelts Around 10th of Ramadan City (LULUCF)	The project aims to protect the 10th of Ramadan city of winds and greening of the area. The initial investment cost (2 years) is 473,251 $ and the marginal incremental abatement costs are 12.29$/tC The establishment of carbon sinks will lead to GHG sequestration of 38926 tC in total, corresponding to 1946 tC/y	The project can be replicated in 32 new cities.	Providing wood. Employment of about 100 people. Improving local environment. Using of sewage water without harm to mankind.	Financing and possibility of attack by pests.
CDM 60 MW Wind Farm	CDM 60 MW Wind Farm on the red sea in Comparison with BAU 45 MW Steam Turbine (Mixed fuel) The initial investment cost is 54 M$ and the marginal incremental abatement costs are 30.2 $/tC GHG emission reductions will be 40138 tC/y as the CDM project substitution reduces emissions from fossil fuelled power stations	3	n.a.	Financing of investment, new technology to Egypt, local acceptance of wind farm, electricity tariff uncertainties

Table 8.7 Criteria indicators range for selected Egypt NSS projects

		Wind Farm vs. Steam Turbine	LULUCF	CNG in Transport	Zenotex	Cogeneration at Misr Elmonifia
	Allocation Weight			Score		
1. Economic Benefit	**(80)**					
Infra structure	10	2	2	2	1	1
Export Potential/ import substitution	10	1	0	0	1	1
Payback period	30	0	0	2	2	2
Energy savings	20	2	2	2	2	2
State of technology	10	2	1	2	2	1
Weighted average	80	1.13	0.88	1.75	1.75	1.63
2. Environmental	**(20)**					
Improvement in environmental performance	20	1	2	1	1	1
Weighted average	20	1	2	1	1	1
3. Social	(10)					
Employment	10	1	2	1	1	1
Weighted average	10	1	2	1	1	1
Weighted average for 1, 2 and 3	**(110)**	**1, 09**	**1,18**	**1,55**	**1,55**	**1,45**
4. Criteria for International Investors View	**(70)**					
Profitability	20	0	0	1	1	1
Investor Image	20	2	2	1	1	1
Project risk	30	1	1	1	1	2
Weighted average	**70**	**1**	**1**	**1**	**1**	**1.43**
Total Weighted Average	**180**	**1.06**	**1.11**	**1.33**	**1.33**	**1.44**
Total Score		190	200	240	240	260

Source: Based on Egypt NSS 2002.

Table 8.6 shows the variety of the projects in terms of economic factors, technologies and sectors involved, the potential for additional socio-economic and environmental benefits, and GHG emission reductions. The considerable replication potential of the projects, apart form the wind farm project, is worth noticing, particularly since the majority of the projects are associated with net benefits without the inclusion of any carbon credits. Of the 5 projects, two have positive marginal incremental abatement costs: the wind farm (30.2 \$/tC) and the LULUCF (12.29 \$/tC). In the latter case, there is, however, reason to believe that the inclusion of social and environmental benefits that are not captured in the selected set of criteria, i.e.

provision of wood, certain local environmental effects and use of sewage water, would change the result regarding the profitability of the project. Table 8.7 below shows the criteria indicators range for each of the 5 projects selected.

In Table 8.7, the weighted average of the scores for the national set of criteria related to the economic, social and environmental dimensions is reported separately to allow a comparison of the ranking of projects with and without inclusion of the international investors' perspective. It is noted that the ranking of projects changes depending on the two perspectives and that the ranking seems to be very sensitive to the value of the pay back indicator under the economic criteria. Similarly, the high weight allocated to the economic indicators, implies that the only project that scores a maximum on the social and environmental criteria, i.e. the LULUCF project, only comes out as number four of the five in terms of ranking.

8.4 Case Studies: The CEA Approach

In this section, we provide case studies from three countries: Egypt, The Philippines and Uganda. In each case CDM projects are considered, using basic data provided by the national teams that put together the original projects, as well as other supplementary information that is available in the public domain.

As mentioned in the previous chapter, CEA is a commonly applied methodology for assessing project level impacts and for financial project analysis. On this basis, it may often be relatively simple to include a few critical elements related to SD issues in the formal cost effectiveness analysis. Other information of importance to the SD assessment, which cannot easily be integrated into the formal CEA, can then be presented in a qualitative fashion. Here, the judgment of the analyst in terms of its importance is critical in arriving at a review that is useful to policy makers. The outlined approach has the advantage of avoiding integrated comparisons of indicators with different measurement units.

It is assumed that all projects considered here have met the *due diligence*, i.e. they have been reviewed for any environmental and social impacts and found to be acceptable in that regard. It is also assumed that public consultations have been carried out and that the projects have at least broad public support.

8.4.1 Methodology Adopted for the Analysis

The evaluation of each project has three components. The first consists of a formal economic analysis, in which the costs and benefits of the project are measured and the net benefits estimated (as described in chapter 7).

As mentioned in chapter 7, no account is taken of the carbon benefits of the project in calculating the NPV. That is, no value is attached to any reduction in carbon resulting from the project. With a positive value for the NPV, no value need be estimated; as the project has satisfied the economic criteria. But with a negative NPV, one asks what minimum value per ton of do we need to switch the NPV value from negative to positive. This critical value can then be compared with the likely price at which carbon reductions can be sold, to see whether the project is now economically justifiable. This carbon valuation is the second part of the evaluation[13].

To capture some of the critical issues related to the projects' contribution to SD, other factors than the economical needs to be included. Hence the third part of the assessment is to look at these other factors. Ones included here are:

a. Employment effects: does the project create jobs or destroy them?
b. Environmental effects: Particularly health benefits from reduced local air pollution
c. Foreign Exchange Requirements
d. Government Funds Used in the Project
e. Risks of failure (technical and commercial)

Given the available data, it has not been possible to include possible impacts on income inequality and poverty in affected groups. Similarly, an assessment of the changes in energy consumption in the effected group has been prohibited by lack of data. Below, c and d are reported in monetary terms (USD per ton of CO_2). To the extent possible, valuation has been carried out for b. Methods have been developed for estimating the environmental health impacts in terms of years of life lost and costs of illness. Each year of life can be valued in terms of lost output, or in terms of what individuals would be willing to pay to avoid the risk of that loss. Reductions of illness are then measured in terms of the cost savings and reduced losses of earnings[14]. The employment effects (a) are reported in man-years per 1000 tons of CO_2, whereas the assessment of risk is qualitative.

An implication of the above is that all information cannot easily be synthesized into one measure of the success of the project. Some of the attempts to do so using multi- criteria analysis (MCA) were reported in the previous section. Here it is assumed that the policy maker will be given a range of indicators about the project and some recommendations as to how they stack up or compare in absolute or relative terms. The following case studies show how far one can get without a formal MCA when looking at CDM projects. More details can be found in the technical background paper supporting these guidelines.

13 No discount rate is applied to the carbon reductions in calculating the critical price. Given the low rates used for this purpose, it will make little difference to the conclusions and the issue is controversial anyway.

14 More information is available in the technical report supporting this chapter.

8.4.2 Overview of the CEA Case Studies

As mentioned in the beginning of this section, case studies for three countries are considered: Egypt, The Philippines, and Uganda. Table 8.8 below provides an overview of the case studies, including a short description of the projects, the main environmental benefits or costs, employment impacts, and a risk assessment The table shows that the case studies cover a number of different types of CDM projects: hydro, wind, solar, fuel-efficiency, agro-forestry and eco-tourism. Similarly, in terms of GHG emission reduction, the projects cover a broad range from a mere 96 tons of CO_2 (the Philippines Pico micro hydro battery charging station) up to 8,569,000 tons (the Egypt hybrid power irrigation project). It is also noted that all projects apart from the land-use oriented are associated with positive environmental health benefits, but that the effects on employment vary considerably between projects. Finally, the risk of failure associated with the projects is not negligible and must be taken into consideration in the more detailed analysis of the projects based on the evaluation of the other key indicators.

8.4.3 Evaluation of Key Indicators

Before we turn to the evaluation of the key indicators for the projects, a few comments are in place. The information regarding the Egyptian case study is taken from Kamel and Dahl 2004. The micro-hydro studies for the Philippines are taken from the 'Green IPP Project Development' prepared for the Philippine Rural Reconstruction Movement, whereas the bagasse cogeneration project information is based on a study undertaken by CREF/IIEC, global not-for-profit organization affiliated with the American Society of Civil Engineers (ASCE). The costs of project development have been included in the detailed costs provided.

The case studies for Uganda are taken from the 2001 National Report on Capacity Building and CDM. The report selects a number of projects, which show a wide range of different impacts for periods ranging from 10 to 25 years. In calculating the costs of these projects, a fixed cost of $25,000 has been added for project preparation, plus 3 percent of project cost for monitoring and certification, as these were not included in the project document information. These apply to all projects except the micro projects, where the fixed cost is assumed to be shared across ten projects. The numbers are only illustrative and can be modified based on experience.

Table 8.8 Overview of CEA case studies

PROJECT	DESCRIPTION
Egypt	
Hybrid Power Irrigation Project	The project involves the installation and operation of a stand-alone diesel-wind hybrid power system for an off-grid farm in Egypt to replace an inefficient diesel-only power system. Power is needed to supply two types of load demand. The first is the load from basic human activities, such as operation of electrical appliances in farm workers' residential quarters. The second is from submersible water pumps used to supply the farm irrigation system with groundwater. An emission reduction of 8,569,000 tons of CO_2 is to be realised over 20 years.
The Philippines	
Pico Micro Hydro Battery Charging Station	A 5kW micro hydro plant generating enough electricity to charge automobile batteries for 25 households, thus providing them with electricity for lighting, TV etc. Presently they use kerosene and disposable batteries, which provide a poor substitute. 96 tons of CO_2 will be reduced over 15 years.
Tabadiang/Lanipga Micro Hydro Plant	The plant has a 10kW capacity and will connect 60 households who currently use kerosene and disposable batteries, which provide a poor substitute. The emission reduction is 73 tons of CO_2.
Gawahon Micro Hydro Project	The project will provide electricity to an eco-tourism centre that currently uses electricity from a diesel-powered generator. Replacing diesel with the micro-hydro is expensive but it has environmental benefits in terms of less pollution and promotion of eco-tourism. GHG emissions will be reduced by 222 tons of CO_2.
Carlotta City Bagasse Project	Installation of a 20mW plant to co-generate heat for the sugar mill and electricity of more than one sugar mill, replacing generation from fuel oil. Savings in generation costs and health benefits of using less fuel oil are quantified. GHG emissions will be reduced by 2,303,230 tons of CO_2 over 30 years.
Uganda	
Solar Photovoltaic Project	72,000 PV will be installed to replace the use of kerosene in an area without electricity. The ensuing change will reduce GHG emissions by 89,119 tons of CO_2 over 10 years. Other benefits include those of electricity supply as a better quality fuel and reduced health impacts from less kerosene.
Paidha Micro Hydro	The project will supply hydro electricity to the West Nile region, which currently uses diesel generators. 2,312,110 tons of CO_2 will be reduced over 21 years. Other benefits include less harmful emissions of fossil fuel pollutants and a more reliable supply but tariffs will be too high to be affordable for poor households who will need a subsidy.
Kampala Traffic Flow Improvement	The project will replace 4,500 minibuses with 900 buses that are more fuel-efficient. The result is a fall in GHG emissions of 1,126,690 tons of CO_2 over 10 years. Other benefits include less congestion and less pollution.
Ajoki Mixed Farm/ Agro-forestry	The aim is to take 100 ha of grassland and use it to grow fruit trees, which will sequester carbon and generate local income. Some of the fruit could be exported and 27,525 tons of CO_2 will be reduced over 25 years.
Tropical Environment Eco-tourism project	This mini project will arrest unsustainable deforestation on 12.15 ha of private land. The land will be turned over to sustainable harvesting of the biomass, and to generating income from eco-tourism. The amount of carbon sequestered is a modest 1,002 tons of CO_2 equivalent over 25 years. Additional benefits are the job creation and shift to sustainable use of the forest. Costs are the loss of present use of biomass and costs of setting up the eco-tourism facility.

ENVIRONMENTAL BENEFITS/COSTS	EMPLOYMENT IMPACTS	RISK OF FAILURE
Health benefits from reduced emissions from diesel, which have respiratory and other negative impacts. These effects have been valued.	130 man-years of labour are lost, taking account of jobs lost in import and distribution of kerosene and jobs created in construction of plant.	If systems break down repair is difficult. Experience with use of technology is not so great and there may be teething problems.
Less kerosene use has health benefits. Better quality energy has value. Neither has been quantified.	3.42 man-years of labour are created from project labour. No allowance has been made for any loss from less kerosene distribution or gain from battery distribution.	If systems break down repair is difficult but project lifetime is not long.
Less kerosene use has health benefits. Better quality energy has value. Neither has been quantified.	14.24 man-years are created from project labour. No allowance is made for any loss from less diesel operations.	If systems break down repair is difficult but project lifetime is not long.
Health benefits quantified. Eco-tourism facility may get more customers or each customer may be willing to pay more.	30.2 man-years from project labour. No allowance is made for any loss from less diesel operations.	If systems break down repair is difficult but project lifetime is not long.
Health benefits quantified.	875 man-years created from project labour. No allowance is made for any loss from less diesel operations.	Project has a long life time and technology may have some teething problems
It is not feasible to value the environmental benefits of not using kerosene given the available data. Also, electricity provides higher quality energy, for which willingness to pay is greater than the cost of kerosene it replaces. This is not accounted for.	21,000 to 24,000 man-years of labour lost, depending on whether domestic producers are used. Account has to be taken of jobs lost in import and distribution of kerosene.	If systems break down repair is difficult but project lifetime is not long.
Less environmental damage from lower air pollution, which has been valued. The impacts of hydro on environment are assumed mitigated as far as possible.	15,279 man-years of labour are lost. There is some job creation with the construction of hydro, but jobs are lost in diesel distribution.	Carbon saved depends on hydrological conditions and smooth operation of new plants
Less environmental damage from lower air pollution, which has been valued. Reduced congestion is not accounted for in this assessment.	14,850 man-years of employment are lost. The jobs lost in the minibus business, are not made up by jobs in buses.	The assumption that people will switch whole scale to buses, which are less flexible, is too optimistic. Issue of quality of service not addressed.
Reduced soil erosion.	2,800 man-years are created. The jobs are created over 25 years at 200 jobs initially and 100 a year from year 4.	Possibility that tree production fails is not allowed for. Experience with other agro-forestry projects indicates this risk is quite high.
Benefits in the form of reduced soil erosion and protection of forest biodiversity are not quantified	315 man-years are created in the handicrafts sector.	Difficulty will be in preventing continuing deforestation if change of ownership means lack of policing etc.

In Table 8.9 below, the key indicators for the 10 projects are summarised. All figures are in US$ per ton of CO_2 except for employment, which is reported in man-years per 1000 tons of CO_2 and the IRR, which is given in percent. In order to ease comparisons between the different projects, a 10% discount rate has been applied in the evaluation of all 10 projects. Total net costs (without local environmental benefits) are obtained by subtracting the direct benefits from the direct costs. Total net costs including local environmental impacts are given as direct cost minus direct benefits minus local environmental benefits. Since the total net cost is given in US$/tC, it corresponds to the critical value of carbon, in the cases where the total net costs are positive. The numbers for foreign exchange and government funds have not been included in the total net cost calculation, but are reported separately in monetary terms.

A number of general observations can be made based on Table 8.9. First of all, it is noted that out of the ten projects, four are associated with positive net costs at a 10% discount rate. The other six are economically viable even without the inclusion of any local environmental benefits. Another point is that there is no immediate connection between a projects' potential for earning foreign exchange or its implications regarding government funding and its economic viability.

It can also be seen that there is a large variation in the projects' employment creating potential and that the conclusions regarding the significance of the employment impacts, depends on whether these are considered in man-years per ton of CO_2 reduced or in total number of man-years created or lost by a given project. If we look at the numbers in terms of man-years per ton of CO_2 reduced, four out of the ten projects are associated with a loss of employment (i.e. the hydrid power for irrigation, the solar photovoltaic, the Paida mini hydro, and the Kampala traffic project), which is only of great magnitude in the case of the solar photovoltaic project, whereas job creation in five of the ten projects is considerable (i.e. the Pico, the Tabadiang, the Gawahon, the Ajoki, and the Tropical eco-tourism project) and in the remaining Carlotta bagasse project insignificant but positive.

If total number of man-years are used as a basis, these conclusions are somewhat altered. Here, we see that out of the four projects with negative employment impacts, three are associated with a substantial number of jobs lost (i.e. the solar photovoltaic, Paida mini hydro, and Kampala traffic projects). Only in the case of the Egyptian project is the loss of jobs rather insignificant, when measured in total number of man-years lost. In the same way, the conclusions regarding the projects with positive employment impacts are different from this perspective. Accordingly, the conclusions are that the Carlotta bagasse, the Ajoki, and the tropical eco-tourism project are associated with significant positive employment impacts, whereas the employment impacts of the Tabadiang and the Gawahon projects are rather modest and those of the Pico project are insignificant.

Table 8.9 Summary of key indicators for the CEA case studies

PROJECT	DIRECT BENEFIT	DIRECT COST	LOCAL ENV. BENEFIT	FOREIGN EX-CHANGE*	GOV. FUNDS	TOTAL NET COST		EMPLOYMENT		IRR***
	Figures are in US$/Ton of CO2							Man Yrs/1000 tons CO2	Total no. of Man Yrs	%
						W/Out Env.	With Env.			
Egypt										
Hybrid Power for Irrigation	54	16	13	-13	-4	-37	-50	-0.02	-130	35
Philippines										
Pico Micro Hydro	140	118	n.a.	-29	0	-22	-22	36	3.42	20,2
Tabadiang Micro Hydro	132	150	n.a.	-71	0	18	18	136	30.24	7,2
Gawahon Micro Hydro	10	117	21	60	0	107	85	96	18.5	0**
Carlotta Bagasse	19	15	49	-5	0	-4	-53	0.38	875	16
Uganda										
Solar Pho-tovoltiac (4)	123	370	n.a.	0 to 370	112	247	247	-237 to -269	-21,102 to -24,016	0**
Paida Mini Hydro	98	8	1	-92	9	-90	-91	-7	-15,279	44
Kampala Traffic	136	100	1	186	20	-36	-37	-13	-14,850	n.a.
Ajoki Mixed Farm (5)	118	22	n.a.	-29	4	-96	-96	101	2,800	67
Tropical Eco-Tour-ism	11	11	n.a.	0 to -18	8	1	1	314	315	5

* Negative number implies foreign exchange earned by project
** Even at a zero rate of discount and leaving out carbon benefits the project generates a negative net benefit
*** Without local environmental benefits and carbon credits

Going into more detail and starting from the top, the Egypt **hybrid power for irrigation project** clearly passes the economic test and will in addition be associated with significant carbon benefits if the reduction of 8,569,000 tons is realized. The local environmental benefits of the project are the health benefits generated from the reduction of emissions from diesel, which have respiratory and other negative impacts on the population. If we include them as economic benefits, the IRR goes up to 45%. The project is also attractive on other grounds. It saves on foreign exchange and on government subsidies to diesel. These savings are considerable relative to the costs of the project. The only negative aspect of the project is some small loss of employment as a result of the use of less diesel. This is only 130 man-years over a period of 20 years of time, or about 5-6 jobs every year. There are some risks with the project, principally the use of a new technology in the region, which may cause some problems in the early years, but should not pose a long term threat to the project.

Even without undertaking an MCA the analyst can strongly recommend this project to the decision-maker. There are no groups that lose out to any major extent and the gains in many dimensions are significant. As we have not been able to compare this project with others in Egypt, we cannot say how attractive it would be in relative terms, but judged in absolute terms it can be considered highly viable.

The **Pico micro hydro project** also passes the economic test at a 10% discount rate and it should be noticed that in this case it has not been possible to evaluate the local environmental benefits encompassing the personal and social benefits of electricity over kerosene in quality terms[15], the health benefits of not using kerosene, and the environmental benefits of avoiding poor disposal of batteries. These benefits are important, especially the quality benefits of electricity over kerosene, and their inclusion would make the project more attractive. In addition, the project is associated with the possibility of creating some foreign exchange and has small but positive employment implications. The risk of the project is that of system breaking down and not being able to be repaired but this is seen as small.

The **Tabadiang micro hydro project** is the first of the projects listed in Table 8.9 having a positive total net cost and it is seen that the critical value of carbon in this case is 18 US$/ton, which would seem to be rather high at a first glance. However, as with the Pico micro hydro project the same important local environmental benefits have not been quantified, all of which are favourable to the project, and it is very likely that their inclusion would make the project pass the economic test. Until the health benefits have been quantified, the final choice would need to weigh the economic indicators against the non-economic. Perhaps a MCA could be of use in this case. The difference between the Pico and this project also shows the cost effectiveness of using a battery charging facility versus full connections for such small systems.

The **Gawahon micro hydro project** is different from the other micro hydro projects in that it provides renewable electricity to a unit that already has access to fossil fuel based electricity. The facility is an eco-tourism centre, which would make use of this source, primarily for environmental reasons. The project has the highest total net costs of all the micro hydro projects and has no IRR if we leave out the carbon benefits. This is to say that even at a zero rate it generates a negative net benefit without carbon benefits. Hence on economic ground, the project would clearly not pass the acceptability test.

In this case, the health benefits from less emissions of diesel have been quantified, but although they are significant, including them does not change the fact that the project has no IRR, unless carbon benefits are included. Even with these benefits a price of carbon of $85/ton is needed, which is still unacceptably high. In addition, the project has a foreign exchange cost of 60 US$/ton of CO_2, whereas the other micro hydro projects had a foreign exchange saving and a risk of failure, which is considered moderate. On the positive side, a small number of 18.5 man-years of employment are created (but not at an effective cost) and there will be increased revenues from eco-tourism when electricity is from a renewable source (positive, but probably small). In conclusion, this project seems to be the least attractive of the three micro hydro projects from the Philippines.

Of the Philippines projects, the **Carlotta city bagasse project** is of a different order of magnitude altogether. Instead of dealing in 3-10kW we look at a 20mW plant – more than 1000 times bigger. With a net total cost of –4 US$/ton CO_2, the project passes the economic test. The net impact of the project on foreign exchange is to generate considerable savings. When the health benefits amounting to two and a half times the direct benefits of lower cost production are included, the project becomes very attractive, which is also demonstrated by the fact that the inclusion of the health benefits raises the IRR from 16% to 88%. In addition, the project creates a total of 875 man-years of employment. Since the health benefits have been estimated quite roughly, they should be looked at in more detail before making a final decision on the project. Finally, the technical and commercial risks are also considered important and need to be looked at more closely.

Before turning to the Uganda case studies, it is worth noting that in the background material (i.e. the 'Green IPP Project Development' and the study undertaken by CREF/IIEC referred to earlier) used for the analysis carried out here, a discount rate of 24 percent was stated to be the going rate for private investments in this part of the Philippines. This is a very high rate at which the economic analysis shows that all of the 4 projects are marginal or not acceptable, if we do not consider the environmental and/or health benefits of the investments. Without either of the non-quantified benefits, all the micro hydro projects would not be acceptable, with the possible exception of the Pico Micro Hydro. The bagasse project could be acceptable, although most CDM projects with this level of risk would only be able to raise around $5/t.C and the project would need $8/t.C to be viable at a 24% test discount rate. This illustrates a very important point: that the results and recommendations are highly sensitive to the choice of discount rate

Turning to the Uganda projects, the basic indicators of the **solar photovoltaic project** shows that the cost of installing the new systems is rather high, compared to the benefits. The critical carbon value is $247 per ton of CO_2. This is of course a very high value and not acceptable in any CDM project framework. In addition, the project could have a high foreign exchange demand if the equipment has to be imported. On the other hand, if the equipment has to be produced domestically, a subsidy of 30 percent of the cost will have to be provided, which imposes a cost on the government. The budgetary cost, however, may be partly recovered from the sale of carbon credits. Another issue is that the project would lead to a loss of 21,000 to 24,000 man-years of employment and has a medium to high risk of failure, because equipment of this kind can break down and, if it does, repair is difficult for poor/middle income households to undertake. This is in spite the fact that the period of the project is relatively short.

One of the only arguments in favour of the project based on the present analysis is that the shift from kerosene to solar energy saves the use of fossil fuels in the home, which provide a poor substitute for electric lights and can cause indoor air pollution. Neither of these benefits have been estimated. We have already noted the lack of studies of the social value of electricity replacing kerosene. While some attempt has been made to value the health costs of pollution from indoor burning of coal and wood, no such studies are available for kerosene. Hence only a qualitative value can be attached to these benefits, which could be significant. In conclusion, the project is not economically justifiable and so the case would rest on showing that the social and environment benefits made up for that. Some MCA type analysis would help in this regard.

The **Paidha mini hydro** project is much bigger than the photovoltaic project and will provide hydropower to residential and commercial users in the West Nile area of Uganda. Presently diesel generators provide electricity, both by the electricity board and by private enterprises. This will be replaced by hydropower. From an economic perspective, this project looks attractive. It has an IRR of 44% and although the quantified local environmental benefits are of a modest size, the net total cost is $-90 per ton of CO_2 without including these benefits. In addition, the GHG emission reductions, amounting to a total of 2,312,110 tons, would generate useful revenues for the government. It should be noted that the project may have environmental costs in terms of loss of biodiversity, health risks from vector borne diseases etc. It is assumed that these costs have been eliminated or at least minimized in the design of the project, which is considered acceptable. Also, the project will lead to a loss of employment of a total of 15,279 man-years due to the loss of jobs in the diesel distribution.

Other key features of the project are: that the project provides a significant saving in terms of foreign exchange; around $224 million over the 21 years of the project, and around $7-8 million annually in 2004-2005, going up to $99 million by 2021; and that there is an issue of budgetary support. The government is assumed to finance the project from its investment resources, which implies a cost of $21 million in the first four years. If, however, carbon can be sold forward, some of this cost can be recovered. Hence although carbon sales are not critical to the project's feasibility, they are important from a budgetary perspective. The budgetary support is assumed not to include any support for poor residential users. Rather any such support would come from higher tariffs for richer non-residential users. But if the former are a very large group the tariff for the non-residential users may be too high and they would prefer to use their present generators. This issue needs to be explored further before the budgetary implications can be assessed.

In conclusion, this project is attractive on the economic criteria and also for most non-economic criteria, although the loss of employment and the need for budgetary support may be constraining factors.

The **Kampala traffic flow improvement** project seeks to replace minibuses with larger more efficient buses in Kampala. The project passes the economic test with a total net benefit of $36 per ton of CO_2. The benefits are derived primarily from the lower operational costs of buses versus minibuses, including the use of less fuel of bus load factors are as high as has been claimed. Furthermore, there are some environmental benefits of reduced air pollution, which have been quantified using the same methodology as for the Paida Hydro Project. They amount to about $1 million, which is not significant in the overall picture but could be useful in any MCA. In addition, there are some benefits of reduced congestion, which are positive, but have not been quantified.

Although the project looks attractive from an economic perspective, some of the underlying assumptions may be challenged and should be looked at with greater care. Particularly, minibuses have some convenience advantages over larger buses, which has been ignored and the assumption that each is equally attractive to users may well be incorrect. The non-economic indicators are generally positive. There is, however, a large loss of jobs in the minibus sector (14,800 man years), which would create social problems if not addressed if the project is to go ahead.

The **Ajoki mixed farm/agro-forestry** project looks quite attractive from a number of perspectives. From an economic perspective, it has total net benefit of $96 per ton of CO_2 corresponding to an IRR of 67%. The non-economic indicators are also generally positive. The project creates 100-200 jobs, implying employment created of 2,800 man-years over the project life time. The use of government funds is small (and even these could be zero if the project is entirely financed outside budgetary funds)[16]. There is also the prospect of some gain in foreign exchange, starting at around $50,000 and increasing to $190,000 annually.

There is, however, one key issue that needs to be addressed and that is the risk of project failure. This arises from failure in maintaining the trees and generating

---

15 One way to obtain the benefits of electricity over kerosene is to estimate the willingness to pay for the replacement. This requires a CVM study (see Chapter X for details), which has not been carried out here.

the fruit output. From previous experience with agro forestry projects this can be quite high and therefore more information on the size of that risk and how it may be mitigated is needed.

The last of the projects for which a CEA has been undertaken, is the **tropical environment eco-tourism** project. This project is of a much smaller scale than the other projects from Uganda, entailing a direct cost of only $11,000, including the costs of project preparation, certification and monitoring, which amount to nearly $6,000 ($50,000 in total shared among 10 projects). Including even the modest project preparation costs referred to above makes this project look uneconomic. It has an IRR of only 5%, which means that at a 10% discount rate, it is not viable. However, to make it viable we need a price of CO_2 of only $1 per ton, which is of course low by most standards. Furthermore, the project should have some forest conservation benefits in terms of biodiversity, soil erosion etc, which are not quantified and should generate foreign exchange from the sale of handcrafts. It creates about 15 jobs, or 315 man-years of employment over the 25 years. Budgetary funds demanded are modest and could be eliminated if the project were carried out by an NGO. The main risk of the project is of failure if the deforestation cannot be stopped – i.e. people come and take fuel wood from the site.

In conclusion, subject to being satisfied that the project risks are not too high (and this may require some project design changes), this project should be considered satisfactory without any further analysis using MCA or other methods of assessment.

8.4.1 Conclusions on the CEA Studies

These CEA case studies have demonstrated some important points about project evaluation in the CDM context. The following should be noted:

a. The analysis has shown that the choice of **discount rate** is critical for the evaluation of projects. As noted above, a suggested discount rate of 24% in the cases from the Philippines would imply that all of the 4 projects were marginal or not acceptable if the environmental and/or health benefits of the investments were not considered.
b. The carbon benefits are rarely needed to justify the projects in overall terms. Either the proposals have a total net cost that is negative (i.e. a net benefit) at an acceptable discount rate **without** the carbon benefits, in which case the carbon sales are 'icing on the cake' (true for the hybrid power project, the Pico micro hydro, the Carlotta bagasse project, the Paida mini-hydropower project, the traffic flow project, and the mixed farm project); or they have such a large total net cost that the sale of carbon cannot possibly turn it into something saleable (applies to the Gawahon micro hydro project and the solar PV project). Only for the small eco-tourism project and possibly for the Tabadiang micro hydro project does the carbon sale make a difference between the project

being acceptable and not being acceptable.

c. The real importance of the carbon benefits comes in the **financing** of the projects. They allow the government to recoup the budgetary costs at an early stage, making the financing easier. This may be the factor that ultimately determines the choice of projects, among the ones that are otherwise fairly attractive.

d. Environmental health benefits are difficult to estimate but an attempt can and has been made. Most importantly, however, **they are never critical** in the present examples. In other words, they do not make a difference to the judgment of the project without them. Nonetheless, it should be kept in mind that it has not been possible to estimate these benefits in five of the ten case studies and it is highly likely that their inclusion would change the profitability of the projects in the cases of the Tabadiang micro hydro project and the tropical eco-tourism project. Furthermore, although they are not critical to the results of the economic analysis of the Carlotta bagasse project, their inclusion significantly changes the attractiveness of the project (from a total net benefit of \$4/ton of CO_2 to \$53/ton of CO_2).

e. The key non-quantitative factors are (a) due diligence with respect to environmental and social concerns and (b) risk of failure. As explained in the beginning of the section, we assume the first is taken care of in the pre-screening. The second is important and rarely discussed in the background documents from the countries. In fact it may often be the critical factor, as we point out for several of the projects reviewed here.

f. It is difficult to put all the information in a more succinct form than has been done here, which means that ranking or comparing these projects will not be straightforward. Obviously, it does not make much sense from a national point of view to include all countries in a comparison. However, summarising the information on the main impacts of the projects provided in Table 8.8 and Table 8.9, we see that in terms of costs/benefits per ton of CO_2 the Ajoki Farm and Paida Hydro projects are best, followed by hybrid power for irrigation, Kampala traffic, Pico micro hydro, Carlotta bagasse, tropical eco-tourism, Tabadiang micro hydro, Gawahon micro hydro and solar PV. From a national perspective, the two preferred Ugandan projects also do well on the other criteria, except Paida hydro does not create jobs but the Ajoki project does. Finally Ajoki is a more risky project than the hydro, but does have some non-quantified environmental benefits. In the case of the Philippines, the two preferred projects are the Pico micro hydro and the Carlotta bagasse project. Both projects creates employment, and although the Pico hydro project's employment creating is considerably higher measured in man-years per 1000 tons CO_2, the total number of man-years of employment is significantly higher in the Carlotta bagasse project than it is in the case of the Pico micro hydro project (875 man-years in the former compared with 3.42 in the latter). Both of the projects have the potential for earning foreign exchange. That is about as much information as an advisor can provide consistently across all the projects. If the policy makers needs more (e.g. costs in the first years, possible carbon income etc.) this can be provided as supplement.

g. The case studies have illustrated that performing a CEA for CDM projects does not necessarily imply an inordinately high cost or use of time compared with the use of other decision making tools.

8.5 Conclusions

This chapter has presented and analysed a number of case studies based on three different decision-making approaches, i.e. the checklist approach represented by the SSN matrix tool, multi-criteria analysis, and cost benefit analysis.

The SSN matrix tool is a systematic approach to SD assessment of CDM projects and provides information on SD impacts that is useful when it is combined with data regarding the project cost per ton of GHG abated. One of the main strengths of the tool seems to be that it is relatively simple to apply and it may be particularly relevant for providing a first overview of a portfolio of projects. The tool includes a large number of SD indicators, which may result in some difficulties if the level of detail in the indicators does not correspond to the level of detail in the available project data. Another aspect is that given the bias towards the use of qualitative indicators, the application of scores may involve a rather high degree of subjectivity. In relation to the guidance provided in chapter 6 on the selection of indicators, the SSN matrix tool can be said to fulfil the desirable properties of comprehensiveness and completeness, whereas it is not entirely unproblematic when it comes to measurability and operationality, as well as in terms of the desirability of keeping the set of indicators minimal.

The MCA performed in the Egypt NSS was based on an initial screening for suitable projects covering all sectors of the economy, but focussing on those with the highest GHG emission reduction potential, i.e. energy generation, renewable energy applications, transportation, energy efficiency in industry, and LULUCF. On the basis of this screening, an initial portfolio of 22 projects was selected. A cost calculation was carried out for all the selected projects, providing information on marginal abatement cost (MAC), the cost of saved carbon, GHG reduction potential, and the expected payback period. Following this, each project was assessed using a proposed set of national SD criteria covering economic, environmental, and social dimensions, as well as on a set of criteria from the perspective of international investors.

Compared with the SSN matrix tool, the MCA performed in the Egypt NSS provides

16 Note that the issue of budget support is not the same as whether or not the project is funded by donors. If the donor funding is through the government, it is part of the budget and subject to whatever budgetary restrictions apply.

much firmer guidance on the application of scores to the SD indicators. However, only two indicators were included to reflect environmental and social criteria, i.e. improvement in environmental performance, measured by the degree of compliance with respectively Egyptian legislation and Annex I country legislation, and employment. Furthermore, the environmental indicator does not take into account the possibility that a project simultaneously could result in e.g. environmental benefits in the form of reduced local air pollution and environmental costs in the form of e.g. reduced water quality. As a contrast, five indicators were chosen to cover the economic dimension. It is not entirely clear that this distribution of the number of indicators in each of the three dimensions of sustainable development and the weights assigned to each dimension reflects all important aspects of the national development objectives of Egypt. One suggestion could be to include additional indicators, such as impacts on access to energy and poverty/income generation under social criteria and local air pollution and soil quality impacts under environmental criteria.

The Egypt NSS illustrates a number of points about MCA. First of all, MCA requires that a range of potential projects is considered and that additional information on some kind of financial value of project in cost per ton of carbon is needed for the final evaluation. Furthermore, as the weights determine the final ranking of the project it may be appropriate to conduct a sensitivity analysis of the results to assess how sensitive these are to changes in key weights. In the Egypt NSS, this was not done, but the analysis in this chapter indicates that the results are quite sensitive to relatively small changes in the weights.

While the checklist approach and MCA are useful tools where there is a decision to be made based on different types of information and a single monetary measure is not readily available, it is also possible to use CEA. This chapter has illustrated how a few critical elements related to SD issues can be included in a formal CEA, without necessarily imposing a heavy additional burden on host countries. This approach has the advantage of avoiding integrated comparisons of indicators with different measurement units.

CEA is a commonly applied methodology for assessing project level impacts and for financial project analysis, which implies that much of the necessary information is already available. Other information of importance to the SD assessment, which cannot easily be integrated into the formal CEA, can then be presented qualitatively.

In the ten case studies, the following effects were included: Employment effects, environmental effects, foreign exchange requirements, government funds used in the project, and risks of failure. The case examples illustrated that the environmental health benefits are difficult to include. Although they were never critical in the present examples, their inclusion changes the attractiveness of some of the projects.

The analysis also illustrated that in most cases, the carbon benefits are not needed to justify the projects in overall terms. Either the proposals have a total net benefit at an acceptable discount rate without the carbon benefits, in which case the carbon sales are 'icing on the cake', or they have such a large total net cost that the sale of carbon cannot possibly turn it into something saleable. The real importance of the carbon benefits comes in the financing of the projects. They allow the government to recoup the budgetary costs at an early stage, making the financing easier. As pointed out above, this may be the factor that ultimately determines the choice of projects, among the ones that are otherwise fairly attractive.

Furthermore, the analysis showed that the choice of discount rate and the risks of failure are vital for the evaluation of projects and that ranking of the projects is not straightforward. The latter implies that the judgment of the analyst is critical in arriving at a review that is useful to policy makers.

8.6 References

Government of Uganda, Ministry of Water, Lands and Environment, Department of Meteorology (2001), ***Capacity Building In Clean Development Mechanism in Uganda.***

Kamel, S. and C. Dahl (2004), ***The economics of hybrid power systems for sustainable desert agriculture in Egypt.*** Energy (2004, forthcoming), Elsevier.

Markandya, A. and R. Boyd (1999), ***The Indirect Costs and Benefits of Greenhouse Gas Limitation: Mauritius Case Study.*** Report for the UNEP Collaborating Centre on Energy and the Environment, Roskilde, Denmark.

Markandya, A. and K. Halsnaes (eds.) (2002), ***Climate Change and Sustainable Development. Prospects for Developing Countries.*** Earthscan, London.

Egypt National Strategy Study (2002), ***Egypt's Strategy on CDM.*** The World Bank, Washington D.C.

SSN (2003), ***The SouthSouthNorth Sustainable Development Appraisal & Ranking Matrix Tool.*** Available online at http://www.southsouthnorth.org/

Thorne, S. and S. Raubenheimer (2001), ***Sustainable Development (SD) appraisal of Clean Development Mechanism (CDM) projects – experiences from the SouthSouthNorth (SSN) project.*** Available online at http://www.southsouthnorth.org

World Bank (2002), ***Arab Republic of Egypt: Cost Assessment of Environmental Degradation, Sector Note.*** Report No. 25175-EGT, The World Bank, Washington D.C.

Annex A The SSN Criteria and Indicators Appraisal Matrices

Table of Sustainability indicators included in the SSN Matrix Tool

INDICATOR	COMMENT
Local/regional/global environment	
GHG emissions	Net reduction of GHG emissions measured in CO_2 equivalent.
Water quantity and quality	Water quantity will be measured with the number of people with access to water supply in comparison with the baseline. Water quality will be measured using concentration of main pollutants (including BOD and others) in any effluents generated by the project activity and their contribution, if any, to local water quality.
Local air quality	Air quality will be measured by comparing the concentration of most relevant air pollutants (e.g.: SOx, NOx, particulate matters etc.) generated by the project activity with the baseline.
Other pollutants	This indicator is used to evaluate the contribution of the project activity to reducing the flow of pollutants not already considered to the environment, including solid, liquid and gaseous wastes (including, where relevant, toxicity, radioactivity, POPs, stratospheric ozone layer depleting gases).
Soil condition (quality and quantity)	Soil condition will be measured by comparing the concentration of most relevant soil pollutants, erosion and the extent of land use changes due to the project with the baseline.
Biodiversity (species and habitat conservation)	Change in biodiversity is estimated on a qualitative basis considering any destruction or alteration of natural habitat compared to the without projects scenario. A positive change will be given by previously disappeared species re-colonising the area, a negative change will be given by species disappearing or by introduction of foreign species. In judging this, inputs from local communities should be considered a key resource.
Social sustainability and development	
Employment (including job quality, fulfilment of labour standards)	This indicator is used to evaluate the qualitative value of employment, such as whether the jobs resulting from the project activity are highly or poorly qualified, temporary or permanent in comparison with BAU. Take temporary and permanent as qualifications for job quality.
Livelihoods of the poor:	
- Poverty alleviation	Poverty alleviation will be evaluated by calculating the change in number of people living above income poverty line compared to baseline.
- Distributional equity	This sub-indicator is used to evaluate contribution of the project to equal distribution of wealth and opportunity, in particular marginal or excluded social groups. The indicator combines quantitative - changes in estimated earned income (normalised to the project's starting year) compared with the baseline – and qualitative assessment - improved opportunities.

INDICATOR	COMMENT
- Access to essential services	Access to water, health, education, access to facilities, etc. will be taken as an indicator of social sustainability, measured by the number of additional people gaining access in comparison with the baseline. Access must be directly related to the service and not a-spin off.
- Access to energy services	The CDM and JI provide an important opportunity to improve the coverage of reliable and affordable clean energy services, especially to the poor and in rural areas. Where of a relevant scale, security of energy supply (an indicator of a country's ability to generate the power that is needed for services and the economy in comparison with the baseline), should be taken into account.
- Human and institutional capacity	This indicator is used to assess the project's contribution to raising the capacity of local people and/or communities to participate actively in social and economic development. It comprises thee indicative sub-indicators: Empowerment: The sub-indicator is used to evaluate the project's contribution to improving the access of local people to and their participation in community institutions and decision-making processes. Education/skills: The sub-indicator is used to assess how the project activity enhances and/or requires improved and more widespread education and skills in the community. Gender equality: The sub-indicator is used to assess how the project activity requires or enhances improvement of the empowerment, education/skills and livelihoods of women in the community.
Economic and technological development	
Employment (numbers)	Net employment generation will be taken as an indicator of economic sustainability, measured by the number of additional jobs directly created by the CDM project in comparison with the baseline
Balance of payments (sustainability)	Net foreign currency savings may result through a reduction of, for example, fossil fuel imports as a result of CDM projects. Any impact this has on the balance of payments of the recipient country may be compared with the baseline.
Technological self reliance (including replicability, hard currency liability, skills development, technology transfer)	As the amount of expenditure on technology changes between the host and foreign investors, a decrease of foreign currency investment may indicate an increase of technological sustainability. When CDM projects lead to a reduction of foreign expenditure via a greater contribution of domestically produced equipment, royalty payments and license fees, imported technical assistance should decrease in comparison with the baseline. Similarly a reduced need for subsidies and external technical support indicates increased self-reliance and technology transfer.

The full version of the SSN Matrix Tool

The criteria and indicators with their current definitions are included below in full, and an example of the application of this methodology to one project example in Brazil is included in the annex:

Table 1: The Criteria and Indicators appraisal matrix

Eligibility Criteria	Rating	Assessment
1. Energy project activities qualifying for the CDM	Y/N	It is proposed that CDM projects in the energy sector be confined to those that employ technologies and techniques which contribute to: • End-use energy efficiency (leading to real energy conservation). • Supply side energy efficiency in newly constructed facilities (such as co-generation). • Renewable energy to supply energy services. • The reduction of methane emissions from landfills and other waste-handling activities. The reduction of N_2O emissions from chemical industries and PFC emissions from aluminum production.
2. Real and measurable benefits	Y/N	Only projects in which emissions are measurable should qualify for CDM.
2A. Positive contribution to Sustainable Development	Y/N	Environmental and social sustainable development indicators must all be positive.
2B. Owner allows adequate transparency	Y/N	Owners or their agents must allow transparency in their project development for the sake of broad base capacity building.
Additionality Filters		
3. Environmental additionality	Y/N	Emissions are reduced below those that would have occurred in the absence of the registered CDM project activity.
4. Financial additionality	Y/N	[[Public] funding for [the acquisition of CERs resulting from] CDM project activities from Parties included in Annex I shall [be clearly additional to][and][not result in a diversion of [be separate from and shall not be counted towards] the financial obligations of Parties included in Annex II to the Convention within the framework of the financial mechanism as well as to [current] official development assistance (ODA) [flows)]
5. Investment additionality	Y/N	This criterion can apply to interventions in business-as-usual projects that show both environmental and financial additionality. In order have been implemented anyway, according to a realistic baseline. To receive CERs, CDM projects must be truly additional to those that would have happened anyway
6. Technological Additionality	Y/N	To be eligible as a CDM project activity, a proposed project activity must achieve a level of performance with respect to reductions in anthropogenic emissions by sources that is significantly better than average compared with recently undertaken and comparable activities or facilities within an appropriate geographical area.
Sustainability Indicators		
7. Indicator 1 – Contribution to the mitigation of Global Climate Change	-3 to +3	Global environmental benefits will be measured by the net reduction of GHG emissions measured in CO_2 equivalent according to the IPCC GWP for a one hundred-year horizon. Vector: 0 = No change in GHG emission level compared with the baseline. 3+ = Total avoidance of the GHG emissions predicted. The main difficulty with quantifying this indicator is estimating the leakage (see below). Complete leakage accounting is required within the host country and

		sometimes abroad, for example, in cases where domestic fuels switching results in take back in a range of energy services. For example photovoltaic lighting replaces kerosene for lighting which then provides additional kerosene for cooking.
8. Indicator 2 – Contribution to local environmental sustainability	-3 to +3	Local environmental impacts will be assessed by the percentage change in the emissions of the most significant local pollutant (oxides of sulphur, nitrogen, carbon and other atmospheric wastes; radioactive waste, VOC, TSP or any solid or liquid waste). A weighted average percentage change may be used when more than one pollutant is considered to be relevant. Vector: 0 = No change in emission level of the selected pollutant. 3+ = Total avoidance of emissions of the local pollutant. 3- = Emissions of the local pollutant are doubled. Subjectivity is an unavoidable weakness of this indicator, given the necessary selection of sample pollutants for monitoring.
9. Indicator 3 – Contribution to net employment generation	-3 to +3	Net employment generation will be taken as an indicator of social sustainability, measured by the number of additional jobs created by the CDM project in comparison with the baseline. Vector: 0 = No change in employment level compared with baseline. +3 = Doubled number of jobs. -3 = Elimination of all jobs predicted in the baseline. This indicator is problematic in that it doesn't register a qualitative value for employment, such as whether the resultant jobs are highly or poorly qualified, temporary or permanent, secure or 'flexible'. Figures are also subject to inflation depending on whether direct and indirect jobs are counted.
10. Indicator 4 – Contribution to the sustainability of the balance of payments	-3 to +3	Net foreign currency savings may result through a reduction of, for example, fossil fuel imports as a result of CDM projects. Any impact this has on the balance of payments of the recipient country may be compared with the baseline. Vector: 0 = No change in foreign currency expenditure compared with baseline. +3 = Total avoidance of foreign currency expenditures. -3 = Doubled net foreign currency expenditures. A major difficulty here is that estimates of future prices of imported goods and services replaced by the project can be quite uncertain (e.g. international oil prices).
11. Indicator 5 – Contribution to macroeconomic Sustainability	-3 to +3	The alleviation of the burden on public savings will be measured by the reduction of direct government (national, provincial and local) investments (including budgets of state enterprises) made possible by the foreign private investment in the CDM project in comparison with the baseline. Vector: 0 = No change in public investments compared to the baseline. +3 = Total avoidance of public investments. The challenge here is to calculate the saving of public financial resources net of subsidies and to ascertain the additionality of the foreign private investment
12. Indicator 6 – Cost Effectiveness	-3 to +3	Cost reductions implied by the CDM project in comparison with the baseline will measure the contribution to increased microeconomic sustainability. The value of this indicator will only be positive in the case of "win-win" ("no-regrets") projects. sensitivity of the results to these key assumptions. Vector: 0 = No change in costs compared to the baseline. +3 = Total avoidance of costs compared to the baseline. -3 = Doubled costs compared to baseline.
13. Indicator 7 – Contribution to	-3 to +3	As the amount of expenditure on technology changes between the host and foreign investors, a decrease of foreign currency investment may indicate an increase of

technological self-reliance		technological sustainability. When CDM projects lead to a reduction of foreign expenditure via a greater contribution of domestically produced equipment, royalty payments and license fees, imported technical assistance should decrease in comparison with the baseline. Vector: 3 = No change in foreign currency expenditures with technology compared to the baseline. +3 = Total avoidance of foreign currency expenditures. -3 = Doubled foreign currency expenditures with technology. Data collection on full technology costs can be difficult in some cases.
14. Indicator 8 – Contribution to the sustainable use of natural resources	-3 to +3	CDM projects should lead to a reduction in the depletion of non-renewable natural resources either through the adoption of technologies with higher energy efficiency or through an increased deployment of renewable resources, such as the replacement of fossil fuels with solar or wind energy. In both cases, CDM projects will contribute to a more sustainable use of natural resources. Vector: 0 = No change in non-renewable natural resource use. +3 = Avoidance of all non-renewable natural resources. -3 = Doubled use of non-renewable natural resources. Uncertainty regarding the performance of technological innovations must be accounted for. Again, two well-contrasted project performances can be used to provide a sensitivity analysis.
Subtotal		Depending upon National/Local policy, this sub-total can be weighted (depending on the bias required towards SD requirements) against the Sustainable Development indicators.
Feasibility Indicators		
15. Maximisation of project owner and Southern country benefits	-3 to +3	The benefits to the project investor, owner, and other local and regional stakeholders can be assessed to establish what these could be. If the benefits are limited to the technology and climate mitigation alone the project scores low, however should the project host country also gain economic, social and/or environmental benefits including the sharing CERs and other win-win benefits with project stakeholders and the broader community, the project scores high.
16. Possibilities of South South axis of technology and information transfer	-3 to +3	A desirable outcome of the SSN project is to improve the Southern axis of trade and innovation. Therefore projects that involve a high component of technologies that can be sourced in the south will score high. Projects that have minimum contributions of southern sourced technologies will score low on this criterion.
17. Chances of success in current policy and institutional environment	-3 to +3	The chances of success are a function of a number of parameters; here we are considering the policy and institutional environment of the host country. Is the project intervention in keeping with national energy/environment/trade etc. policy? Is it backed up by the institutions in government? If the answer is yes to both, the project scores high on this criterion. Conversely, if there outright rejection in policy or by the institutions managing the project, it will score low. Policy appreciation of the project ideas without the backing of institutions can be ranked as neutral. Conflict with national policy can be considered a fatal barrier to the project's consideration and the project should be dropped.
18. Barriers to implementation (no fatal barriers)	-3 to +3	An assessment of the size of technical, financial, institutional, human capacity and/or awareness barriers may provide a range of impediments that can vary in significance. Barriers that are entirely overcome by the CDM project score high, whereas projects that are impeded by barriers would score low. Any barriers that are considered to be fatal are to be presented in the introduction to the individual projects, and the project

CDM Sustainable Development Impacts provides a general introduction to policy makers and experts on how CDM projects can be developed and designed to promote sustainable development as required in Article 12 of the Kyoto Protocol. The guideline presents an operational approach to sustainable development in the context of CDM projects. It includes the following aspects: an overview of major steps of a sustainable development assessment of CDM projects, selection and definition of sustainable development criteria and indicators, linkages to national and international development activities, decision making tools, and case study analysis illustrating the potential for exploiting synergies between development and climate change objectives.

The guidebook is produced to support the UNEP project "Capacity Development for the Clean Development Mechanism" implemented by UNEP Risø Centre on Energy, Climate and Sustainable Development. The overall objective of the project is to develop the institutional capability and human capacity for implementation of the CDM in developing countries.

The project is funded by the Netherlands Ministry of Foreign Affairs.

Risø National Laboratory
Roskilde
Denmark